THE GEOGRAPHICAL REVIEW

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THE
GEOGRAPHICAL REVIEW

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SALT IN CHINA*

Joseph Earle Spencer
Inspectorate of Salt Revenue, China

BY force of having four hundred million consumers and of being a semigovernment monopoly salt plays an important part in the domestic, commercial, and political life of China. Salt and iron became government monopolies, more or less, several hundred years before the opening of the Christian era, and salt has ever since provided the central authority, the province, the military feudal lord, the outlaw holder of a transportation route, the local political unit, and, of late years, the national government with a steady source of revenue.[1] It has afforded a living to a host of producers, commission brokers, and distributors while satisfying a fundamental domestic need. In China salt has been listed as one of seven indispensable necessities of everyday human life—fuel, rice, oil, salt, sauce (in which salt is used), vinegar, and tea.

TAXATION ON SALT

Taxation on salt has been levied by government agencies in lieu of a poll tax. Any study of salt in China must, therefore, inevitably deal with governmental control and direction of production, trade, and consumption.[2] It is fundamental that governmentally expressed forces have affected a large part of Chinese life and doings. These forces result from a variety of inspirational agents whose origins and workings may no longer always be possessed of clearly apparent logic. It is probably true that outside the immediate vicinity of saltworks the Chinese people no longer conceive of this primary commodity as

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[1] E. M. Gale: Public Administration of Salt in China: A Historical Survey, *Annals Amer. Acad. of Polit. and Soc. Sci.*, Vol. 152, 1930, pp. 241–251. There is an immense literature on salt in Chinese, covering virtually every possible aspect, primarily as regards administration.

[2] Compare conditions in Ecuador as described by George Sheppard: The Salt Industry in Ecuador, *Geogr. Rev.*, Vol. 22, 1932, pp. 403–410.

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being procurable untaxed, entirely apart from those items of cost required by production and transportation. There are no legal exemptions from salt taxation; the inhabitants of the immediate hinterlands around saltworks are supposed to pay for their salt, though they often steal it instead. This right of a state agent to tax (a salt tax is a basic sales tax) is not yet admitted to be also a right to regulate trade infinitely, and there is still protest against "government interference in trade" after three thousand years. Throughout Chinese history different schools of political economy have held different ideas about state monopoly of natural resources; the general state of trade has suffered many long-time disruptions; efficiency of tax collection and the severity thereof have been irregular; smuggling of salt has been a variable though regular thing.[3] When the empire ended and the modern Inspectorate of Salt Revenue was organized under the republic, taxes were being levied irregularly geographically and on many separate bases; the taxes were in large part "local tolls," an almost inevitable feature in a great area not under one strictly centralized political administration.

Under the present Inspectorate, established in 1913 with foreign assistance and coöperation, much of the old machinery necessarily was carried forward. The administration attempts to maintain standards of quality and quantity in production, to secure adequate regional distribution of salt, to regulate selling prices, and to collect a revenue for the central government. That it has been as yet unable completely to reduce the historic complexity to a simple, evenly borne tax is not discreditable. Traditional elements in China are more resistant to change than in the Western world.

Crude-Salt Production

The sources of China's supply of salt are widespread and diverse. Figure 1 gives sources according to the method of production. The greater part of both crude and refined alimentary salt comes from the seacoast. Saltworks are scattered along the coast from Korea to Indo-China. A small supply of poor-quality salt is found along the Yellow River in Honan, where what is termed "earth salt" occurs. The surface of the earth to a depth of about a yard is impregnated with various salts and yields a product containing 20 to 60 per cent of sodium chloride. The surface earth is soaked with water, which is then filtered and evaporated from "pans." The salt costs only one-third the price of sea salt and is locally used extensively, but illegally, by poor people and by unscrupulous traders for mixing with sea salt to

[3] J. Edkins: Revenue and Taxation of the Chinese Empire, 1903; H. B. Morse: The Trade and Administration of the Chinese Empire, 1908; Chen Shao-kwan: The System of Taxation in China in the Tsing Dynasty, 1644–1911 (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 59, No. 2) 1914; E. M. Gale, transl.: Discourses on Salt and Iron, 1931.

increase profits. This same general method of producing "earth salt," both by solar evaporation and by boiling, is current in many parts of North China where saline deposits occur. As such production is illegal, unmeasured, and intermittent, such works are not shown on the production map.

Throughout the northwest intermittent salt lakes provide a supply of salt for local consumption. The total amount is not known. In southern Shansi, however, such lakes are under definite government control and provide a large quantity of respectable alimentary salt for a considerable market area. In central Hupeh, north of the Yangtze River, gypsum deposits are a source of salt as a by-product of gypsum mining. The mining is done through vertical shafts and horizontal tunnels, following seams in the dry, gray, saline shale. Periodically, after exposure of new tunnel walling, the mines are artificially flooded. After standing for some nine to fourteen months the resulting brine is pumped off and boiled down. At present the local mining practices are so costly that working the mines for either salt or gypsum alone would be unprofitable. The salt so procured is marketed locally.

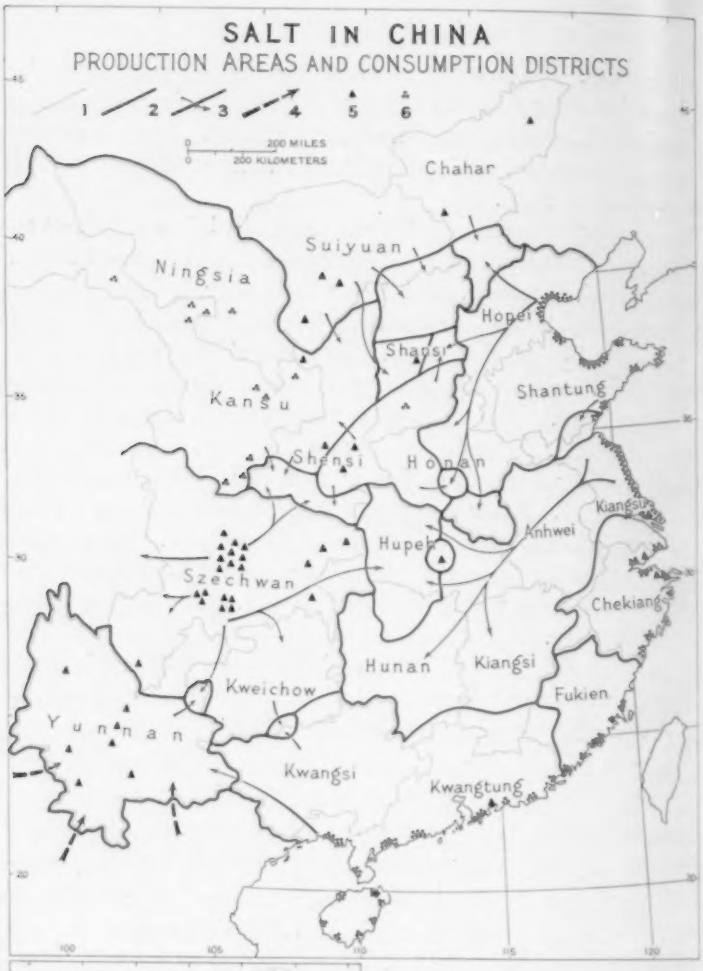
Lastly, in Szechwan and Yunnan a large amount of salt is produced from the salt wells and mines scattered over the two provinces, which supply all of western China and eastern Tibet.[4]

Sea Salt from Kiangsu

In the trade salt is labeled for the administrative district from which it comes, i.e. *Huai* salt from Lianghuai District, Kiangsu Province, *Chuan* salt from Chuannan and Chuanpei districts, Szechwan Province. As may be seen from Figure 1, inspectorate districts often depart from political boundaries. The coast of Kiangsu is now the most important single area of sea-salt production. This district produces primarily crude salt. Most of the refined salt sold in the Yangtze Valley is produced at works in or north of Shantung, though very recently the Huai producers have begun to refine their own salt in competition with the northern refiners.

The Kiangsu works area extends from the northern boundary of the province, against the base of the Shantung peninsula, for some two hundred miles to the mouth of the Yangtze River. It is flat, uninteresting country, low-lying, built up from the deltaic deposits of the great rivers. The bare, open landscape is broken only by stacks of dingy white salt and clumps of workers' huts or by masts of junks on a transport canal. A main sea dike cuts off the evaporation pans from the sea, and feeder canals pierce the line here and

[4] Sir Alexander Hosie: Szechwan: Its Products, Industries and Resources, Shanghai, 1922, pp. 173–182; Wallace Crawford: The Salt Industry of Tzeliutsing, *China Journ. of Sci. and Arts*, Vol. 4, 1926, pp. 169–175, 225–229, 281–290, and Vol. 5, 1926, pp. 20–26.



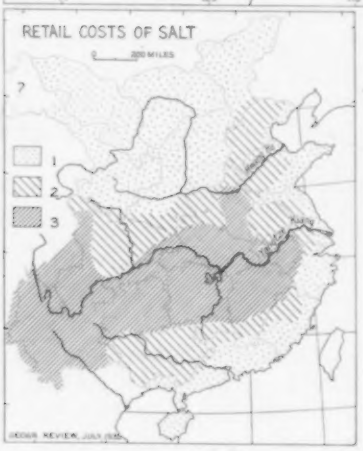


FIG. 1 (above)—Map showing areas of salt production and allocation of consumption districts in China. Numbers have reference: 1, provincial boundary lines; 2, boundary of salt consumption district allocated to the producing works located within the district boundaries; 3, indicates sharing of consumption districts by more than one producing area; 4, invasion by smuggling of Burma and Tongking-Annam salt; 5, salt works operating by boiling method; 6, salt works operating by solar evaporation. Scale 1 : 27,500,000.

FIG. 2 (left)—Map showing distribution of approximate retail costs of salt. Figures represent price per pound in silver currency and are considerably generalized as to area. Where two varieties of salt are allowed in the same district there may be some over-lapping of price, a fact that is also true near consumption-district boundaries. Numbers have reference: 1, 1 to 8 cents; 2, 7 to 14 cents; 3, over 13 cents: in isolated areas perhaps up to 35 cents.

there to admit sea water and the entry and exit of the salt boats. The pans are small, each one hundred to three hundred feet square, and are separated by low walls, which provide a myriad of footpaths. Water is pumped from canal to pan by treadmill or windmill. The pans are usually placed in such a way that water flows by gravity from those first filled into those in which the salt finally crystallizes. Here and there is a slightly raised square of earth upon which the crude salt is stacked awaiting shipment to a government depot or direct to a consumption point in the Yangtze Valley. In the production seasons the works area is dotted with salt stacks twenty by fifty by fifteen feet tall, usually covered with matting for protection against rain. The laborers' huts are on the inside edge of the works or isolated in units in the midst of the pans, ten to fifty in number, closely bunched on raised platforms.

During the spring and early summer, and again in the early autumn, there is great activity in the works. All available pans are filled with sea water to a depth of a few inches. On three successive days the water is shifted from

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Sea salt from the Kiangsu coast being taken into a government-owned storage depot in western Hupeh. The bags are of imported jute and weigh about 265 pounds.

FIG. 4—Szechwan salt from Tzeliuching being weighed by beam scale when entering the government depot in western Hupeh. Bags (older style) are of split bamboo and weigh about 370 pounds.

FIG. 5—A retail salt-selling shop in northwestern Hupeh. A beam scale is hung over the salt bin at the shop front and, as the salt is always sold in bulk, any amount may be purchased.

pan to pan; on the third day the crystallization of salt begins and is completed on the fifth or sixth day if the weather is favorable. The salt is then scraped up and stacked, and more water is let in the last pans to continue the process. All work is done with the simplest of hand tools. The salinity of the sea water is not high at best, and rain is frequent enough to make salt returns variable, but two to four piculs is the normal yield to a pan (by the new metric scale a picul equals 110 pounds). There are thousands of pans in that 200-mile strip of coastland, and the shipment of salt from there reaches an average total of 560,000 tons, more or less, a year.[5] No secondary processing is given the crude salt. All salt for alimentary consumption must, however, contain more than 85 per cent of sodium chloride, and the better grades usually contain more than 95 per cent.

Production is under private management, the government function being purely one of supervisory control. Owners of saltworks may be wholesale transportation merchants, or they may take no part in trade. By treaty no foreigner is allowed to engage in any stage of domestic production or distribution. Import of foreign refined salt is permitted, and small quantities are carried by firms dealing in foreign groceries. Many of the works companies have extensive holdings of salt fields and have distribution contacts up and down the Yangtze Valley. Increasing efficiency in production control is notable, particularly in Kiangsu, where the Inspectorate has constructed canals and storage depots. The plan is to have eventually central depots in which all salt not immediately shipped can be stored, to prevent what in the past has been almost outright robbery by smugglers.

It should be noted that not all sea salt is produced by solar evaporation (see Fig. 1); for not all shores are suitable for ponding. It must have been early apparent to many peoples, as a result of their culinary activities, that boiling of saline water provided a controllable method of producing salt.[6] At any rate, a great deal of salt has always been produced in China by the boiling of sea water, and a considerable amount is still produced in this manner. On the flat delta coastlands extensive growths of wild reed and heavy marsh grass provide a fuel cheaper and more adequate than at first seems possible. Simple layouts, cheap labor, and patience are the additional requisites. With recent improvement in the solar-evaporation technique, however, the boiling plants are slowly dying out. The quality of the salt produced, when expenses are kept low, is too poor to allow competition with well handled, solar-evaporated salt.

[5] In this article the ton is understood to mean the United States short ton of 2000 pounds rather than the metric ton of 2204 pounds, common in foreign use in China. The above figure includes all salt produced on the coast of Kiangsu, which is composed of three administrative districts, two being near and south of the Yangtze River mouth.

[6] Compare L. G. M. Baas-Becking: Historical Notes on Salt and Salt-Manufacture, *Scientific Monthly*, Vol. 32. 1931, pp. 434–446.

The Brine Wells of Szechwan

Production methods in Szechwan and Yunnan differ markedly from those in Kiangsu. Strictly speaking, almost no rock salt is worked in China, and the only known occurrence of pure salt is in southwestern Yunnan in thoroughly inaccessible country. But from salt springs in both Szechwan and Yunnan an extensive industry has developed based on brine wells and springs and on the leaching of saline rocks.[7] Production methods are far more complicated than for sea salt. In Szechwan actual well borings are sunk as deep as three thousand feet by crude machinery, and brine is pumped from them by animal power, chiefly water buffalo.

All salt is obtained by boiling. A boiling plant consists of a furnace, several shallow iron pans, brine tanks, and salt storage bins. Often one plant handles the output of many wells; the landscape in a works area is threaded with flumes and all kinds of contrivances for pumping brine over hill and dale to the boiling plant. With its thickly planted bamboo well rigs[8] the Tzeliuching area resembles an American oil field. Bamboo is a well-nigh indispensable item in the whole process, supplying everything from drilling to salt-transport equipment. Perhaps its most important uses are for piping, for constructing brine flumes, and for lining wells.[9] The salt is produced in three general forms, each having a distinct market: crystal, white cake, and black cake salt. The crystal and white cake salt differ only in that the crystal salt is removed from the boiling pans while the pans contain some liquid, whereas the pans are boiled dry to obtain the cake salt, a circular block a few inches thick and three or four feet in diameter. For the black cake no attempt is made to purify the brine. Deep-well brine is strong and blackish, and it is usually boiled over sooty coal fires. Strangely enough, the murky product that results commands a higher price in its market among the non-Chinese "tribes" of southwestern Hupeh, Kweichow, southern and western Szechwan. The buyers say it is a "sweeter" salt than the white product. The same idea is entertained by the highland people of Ecuador, who prefer the earth-colored crude salt to the finer white product.[10]

Production is widely distributed, and quality and quantity differ greatly. Over most of the area the wells are comparatively shallow, those of Tzeliuching being the only ones to reach considerable depths. At Tzeliuching gas is struck as often as brine and provides a cheap

[7] H. C. T'an and C. Y. Lee: Salt Deposits and Industry of Szechuan Province, *Geol. Bull.* (*Bull. Geol. Survey of China*) *No. 22*, 1933, pp. 39–78.

[8] See the excellent illustrations accompanying Arnold Heim: Das älteste Bohrfeld der Welt, *Atlantis*, 1932, No. 1, pp. 13–17.

[9] Crawford, *op. cit.*, contains notes on the uses of bamboo and also on many of the associated and by-product industries dependent on the Tzeliuching works, as well as a good description of the methods of well drilling and salt production.

[10] Sheppard, *op. cit.*, p. 404.

and good fuel for salt boiling, though practically no other use is made of it. Elsewhere coal and even wood are used in the furnaces. A semirefinement is often given the Tzeliuching crystal salt by pouring a liquid (water in which a variety of bean has been boiled and into which the juice of the bean has been pressed) into the boiling pans and thus causing a flocculation of the impurities, which are then skimmed off the boiling brine. The total production of all Szechwan works is about 425,000 tons a year.

Saline-Rock Mining in Yunnan

In Yunnan there are no wells proper: saline rock is mined and leached with water, or the flow of natural salt springs is gathered and the resulting brine boiled down. A single boiler handles the output of several sources of brine. Local custom isolates the "salt village"—boiling plant, brine-leaching plants, salt storage bins, workers' dwellings, and all accessory structures—within a wall, apart from the ordinary villages and towns. Mining methods are crude. The mines are usually horizontal tunnels driven into cliffsides for only a short distance. When a spring is tapped inside a mine shaft it is sometimes treated as a well, if salty. The total Yunnan production averages only some 35,000 tons a year. This is less than the local need, which is made up by salt from Kwangtung and by Burma and Tongking salt smuggled into the south and southwestern border areas. The local product is usually sold and transported in cake form. Often it is removed from the boiling pans before it cakes and molded into "loaves" of various weights, which are then baked over charcoal fires until dry and hard. Five, ten, and twenty-catty "loaves" are commonest (about 6½, 13, and 27 pounds respectively). A small sale may be sawed off a "loaf" as bread is sliced. Most Yunnan salt is of a color other than clear white and is preferred so.

Crude-Salt Distribution

It has long been the practice to allot definite consumption areas to the producing centers (Fig. 1). Despite the abuses to which this regional demarcation lends itself, it does much to eliminate overlapping services and to maintain a continued supply of salt in border areas where communication is difficult and costly. Over a period of time the market limits may be altered and adjusted in response to a number of causes. Thus when, in a period of general disruption of trade through warfare, an area becomes cut off from its previous source of supply and either a new source is locally developed or a new set of market contacts is brought into play, the new conditions may remain when peace is regained. However, the ousted interests are not usually placated easily. When the Taiping rebellion stopped normal trade

in the Yangtze Valley during the middle of the last century and the Yincheng gypsum interests began commercial production of salt in Hupeh Province to stay the local famine, the product sold widely and soon obtained government sanction for a market area comprising ten counties in central Hupeh. This number has been slowly cut until at present only three counties remain within the legal market zone. Penetration outside this limit depends on the ingenuity of a small trader who, legally speaking, becomes a smuggler. Szechwan, on the other hand, has never been greatly restricted within its own geographical area, since the local sources prove adequate for the regional need. Throughout several centuries northwestern lake salt, sea salt, and Szechwan salt have maintained a bickering competition for a market zone lying outside Szechwan proper, with now one group gaining power, then another.

The artificial manipulation of market areas, with its disruption of the established channels of supply and demand, its relation to production cost, transport-cost control, and consumer cost, is very hard on the well ordered picture of the economic geographer. There is no theoretical justification for the maintenance of production and distribution of a costly salt derived from low-grade sources by inefficient methods other than that the producers and distributors possess a vested interest the abolition of which would mean economic ruin to them. At present sea salt, produced by solar evaporation and transported by steamer to an inland point, is the cheapest salt available in China. Untaxed, such a salt could probably be transported to the Tibetan foothills two thousand miles distant and undersell a brine-well, coal-boiled, untaxed salt produced within two hundred miles of the same spot. Such a free and unlimited working of economic laws has never been permitted in China, and it may be that it is better so. As far as possible, regional distribution has been determined by geographic transport areas. At present most of China is supplied by merchants operating as private businessmen competing in an open market. In the past many schemes of merchant monopoly have been in use—"farming out" of market areas to highest bidders, absolute government transport and sale, and so on. Certain areas are still allotted to monopoly merchants, and a few are even farmed out. The Yangtze Valley is now experimentally operating under partially competitive free trade.

Marketing in the Yangtze Valley

An example of marketing procedures may be drawn from the Yangtze Valley. The consumption area of Huai salt includes the hinterland of the Kiangsu coast, the whole of the Hwai River basin, and the basin of the Yangtze River as far up as Ichang in western

Hupeh. The western half of Hupeh, however, uses salt from Szechwan also. In central Hupeh, as noted earlier, only three counties are the market area for gypsum salt.

The discussion is here applied to alimentary salt only: industrial salt goes primarily into the large coastal cities for use in chemical industries, and fishery salt is consumed almost exclusively along the seacoast; and the quantities of both are very small in comparison with alimentary salt, are practically tax-free, and hardly enter the normal trade channels. All salt must be moved in containers holding a regularly measured amount. In the past salt bags were made of any of a number of marsh grasses or of split bamboo, but since the establishment of the present Inspectorate imported gunny bags have been introduced by most of the sea-salt producers. Although far more expensive, these bags last longer and prevent a large part of the former wastage.

Transport methods differ with the area and the destination. In the immediate delta-plain hinterland small native boats are used and occasionally pack animals. Railroads are made use of for long hauls when possible. The bulk of transport from works to far inland points is by steamer from the Kiangsu coast. The steamers are loaded from lighters fed by small native boats capable of threading the works canals. The harbor now being completed at Laoyao (Haichow is some miles inland from the terminal), the new terminus of the Lunghai Railway, will ease shipment for the saltworks near at hand.

Shipments are made to any port on the Yangtze River allowed by the Customs authorities upon prepayment of a share of the tax levies to the Inspectorate office located in the works area. There are a considerable number of these wholesale distributing centers, at which the Inspectorate also maintains offices. The stock usually passes from the hands of these wholesale transportation merchants, often through the services of a broker, to a class of small wholesale distributors, a natural procedure, for at these transshipment points new conveyances are needed to transport salt either on smaller tributary streams or overland. Here ordinarily another share of the duties must be paid, and sometimes the final full levy is collected.

The new owner is free to transport salt anywhere within a given district; if he goes outside a new tax is assessed, unless he is a successful smuggler. The salt is usually conveyed in small river junks to *hsien* cities (county seats) and other key points, where a second broker may turn over smaller lots of salt to a third merchant. This merchant may be a retail shopkeeper or an itinerant retail or wholesale peddler, who oftenest transports overland. If he peddles his stock to small village shops, a picul or two at a time, there is still this one more dealer who adds a percentage to the price to be paid by the consumer. The

total of three wholesale merchants, two brokers, and one retailer is not uncommon. In the salt trade the broker's services may be purely nominal, the selling merchant supplying the storage facilities and the buyer providing the money for the whole transaction. The broker may expedite a sale by advancing salt on credit, his payment to be returned in agricultural produce at the harvest season. Brokers dealing in salt are almost universally dealers in other commodities also and are often the real promoters of trade. It may happen, also, that the primary transportation merchant himself goes one step further by taking small lots of his big shipments to the smaller centers. In these he often maintains branch shops, which may sell lots of salt of five to five hundred or more piculs at a time.

The itinerant wholesale-retail peddler is often a smuggler also. In the present state of affairs, when local surtaxes still vary within even one administrative district, there is great temptation to transport salt from a light-duty area to one paying a heavier tax. The chance of success is nearly even, and the profit is frequently doubled to this class of trader. Other folk, too, engage in smuggling. For a land in which transportation and communication are conventionally described as backward, there is an immense stream of internal migration constantly going on. Travelers of all stations and types, from pious pilgrims visiting shrines to displaced soldiers on the move, are susceptible to the lure of smuggling. Within the main Yangtze Valley there is little incentive for smuggling, except by steamer passengers traveling from the coast up the Yangtze River. There is, however, considerable incentive for smuggling into the great central valley districts from round about, since the Yangtze Valley consumers pay the highest tax levies. The Inspectorate maintains its own police staff to prevent smuggling of salt from low-duty areas into those paying higher taxes. This preventive work is also carried out by the regular Customs search parties at the major ports. Smuggling, however, remains a discouragement to the compiler of trade statistics; for, although it is largely practiced with many commodities, its amount can never be measured.

In all the major distributing centers there is a branch organization of a Salt Merchants' Guild and usually an independent Brokers' Guild, both serving constructively as clearinghouses, financial houses, and centers of organization.[11] However, there is a contrary aspect; for a strong group of merchants can, if so inclined, wield a heavy hand in the destructive throttling of trade. Monopoly of trading rights within certain favored areas is occasionally "acquired" by stronger merchants within a guild. Not all famines in China result from "acts of God." Herein lies a strong sanction of the present administrative agencies: they have notably reduced this form of willful robbery.

[11] H. B. Morse: The Guilds of China, 2nd edit., 1932.

The population of the area consuming Huai salt, supplemented in part by other crude and refined salts, is about 150,000,000. Consumption capacity of salt is now usually estimated at nearly fourteen pounds per capita, but there is room for doubt whether this figure is really attained. It seems that the actual quota for China is at present only slightly more than eleven pounds per capita, all uses included. Official figures of salt released for consumption, meaning the legally controlled total, show consumption at about ten and a half pounds per capita, assuming the postal-census figure of about 440,000,000 people for China proper. To this total must, of course, be added the illicit total, which, though unknown, cannot any longer be very great.

Outside the Yangtze Valley distribution is somewhat similar to the system just described, except that there is generally less freedom of merchant initiative and the large-volume transport by steamer is absent. For the inland producing areas, however, transport and sale are upon a basis of more numerous and much smaller deals. Production localities are more scattered in relation to the general market, and transport conditions are more formidable. Water traffic, when available at all, is for small-lot shipments, and for overland transport animal and human carriers are far more numerous. Wilson, writing in 1913, said:

> The province of Szechuan is abundantly rich in salt and also in mountain-paths. From a lengthy study I have come to regard this network of bypaths as the result of salt traffic, and more especially illicit traffic. There are to-day many such paths throughout the Hupeh-Szechuan boundary, used for practically no other traffic than that of salt, and by these paths salt still reaches certain districts in defiance of the law. Very useful, if difficult, the traveller finds these bypaths, for without them it would be impossible to traverse some of the wildest and most interesting parts of central and Western China.[12]

Costs of Transportation and Consumer Costs

Steamer transport for salt on the Yangtze River generally averages two, four, and six cents a ton mile for the Shanghai-Hankow, Hankow-Ichang, and Ichang-Chungking sections respectively. Native-sailboat costs on a Yangtze River tributary, the Han River of Hupeh, average slightly less than five cents a ton mile. Railroad costs usually run about seven cents a ton mile. Motor transport (imported trucks and fuel) is costly, averaging from forty cents to more than a dollar a ton mile in different parts of the country.[13] Szechwan salt consumed in far southwestern Hupeh reaches various ports along the Yangtze

[12] E. H. Wilson: A Naturalist in Western China, Vol. 1, London, 1913, p. 26.

[13] The Rajchman Report to the League of Nations, printed in the *China Year Book*, 1934 (pp. 761-793, reference on p. 779), gives figures on transport costs that compare favorably with these, except that the figures for launch and steamer cargoes are for perishable or short-haul cargoes and therefore much higher than for salt.

River by native boats and is then carried by porters to its eventual market in loads of one hundred pounds or less. Cost of transporting salt here averages thirty-five cents silver a ton mile through rugged country.

Cake salt is far easier to transport and is less susceptible to wastage: it is, therefore, preferred by many itinerant peddlers of western China, who often shoulder a cake and travel until purchasers have consumed it. In the north and northwest transport is mainly by cart and pack animals. In the southwest pack animals are used almost entirely, human porterage only slightly.

The generalized map (Fig. 2) of present consumer cost of alimentary salt has interesting features. The largest single price determinant is neither production cost nor transport cost, but government tax.[14] Areas near a producing district pay less tax than distant markets, notwithstanding their lower costs of transport. This is due to the threat of smuggling salt from the works, which heretofore have not been well controlled. Merchant profits are nearly fixed for routine trade and are usually limited. Szechwan and Yunnan salt, as well as Hupeh gypsum salt, pay only a low rate of duty, but increased costs of production and transportation make consumer costs about as high as those paid in the main Yangtze Valley, which consumes low-cost, highly taxed salt. The lake-salt works of the northwest are, as yet, very poorly controlled and irregularly worked and pay low and somewhat variable rates of duty. Consumer cost is relatively low, but the quality of the salt is nowhere high.

Preparations are being made for the introduction of one simple national rate of tax to be assessed and collected only at the producing works, this being the acme of improvement striven for by the Inspectorate Service. So deep-rooted is the present mode of tax administration and so much of a novelty is this plan that it is yet unfeasible. Economic history of two millenniums cannot here be reversed in two decades.

Refined-Salt Production and Distribution

Refined salt, the "table salt" of the Western world, is a comparatively recent cultural innovation. China, as well as many other lands, still uses salt in the coarse crystalline form in which it is initially precipitated from a state of solution. In Chinese food economy there is a fundamental difference from the European practice. Seasonings are either added to the food during cooking or included in sauces; thus there is no objection to a coarse-grained salt. For salting down vegetables or meats for storage a coarse salt is equally suitable. For-

[14] The mean rate of duty for all China is now nearly $4.00 silver per hundred pounds. In terms of salt released at varying duties the following percentages are approximate: less than $1.00, 10.9; 1.00 to 3.00, 22.4; 3.00 to 6.00, 32.1; 6.00 to 9.00, 21.7; 9.00 to 12.00, 5.5; more than 12.00, 7.4.

merly refined salt, exclusively an imported product, was to be found only in a few treaty ports; but today refined salt of native origin is to be had in many of the more accessible parts of the country. When production began, its sale was restricted by government order to the open treaty ports of the seacoast and Yangtze Valley, and although still nominally restricted in the same way a considerable amount filters out from these points to the more accessible parts of the country. Most of the production of refined salt takes place in and north of Shantung and is restricted entirely to the sea-salt works.

Wholesale transportation is in gunny bags by steamer to the centers of distribution, where all refined salt must be packaged in uniformly labeled, one-pound paper containers. But as the salt refiners are neither so numerous nor so well organized as the crude-salt traders, they have not the widespread guild branches through which transporters may work. Trade competition with the crude-salt dealers is keen, and there is a historic prejudice to break down. The total quantity of refined salt sold yearly amounts to only about 4 per cent of the total consumption of all alimentary salt, or about 95,000 tons a year. Wholesale and retail prices of refined salt are slightly higher, on the average, than those for crude salt.

TOTAL YEARLY PRODUCTION OF SALT AND BASIC PRODUCTION COST

PRODUCING AREA*	TONS OF 2000 LBS.	COST PER 100 LBS. SILVER CURRENCY	PRODUCING AREA	TONS OF 2000 LBS.	COST PER 100 LBS. SILVER CURRENCY
Hopei	330,000	$0.10 to 0.75	Honan	unknown	unknown
Shantung	420,000†		Shensi	unknown	
Kiangsu	560,000	0.35 to 1.50	Shansi	98,000	0.45 to 6.00§
Chekiang	280,000	0.50 to 3.00	Chahar	15,000	unknown
Fukien	84,000	0.10 to 2.50	Suiyuan	unknown	
Kwangtung	266,000		Ninghsia	6,000	
Yunnan	35,000	1.00 to 10.00§	Kansu	17,000	
Szechwan	425,000				
Hupeh	14,000	3.00 to 5.00	16 provinces	2,550,000	

*Figures have been rearranged into totals for provinces.

†Including 210,000 tons exported to Korea and Japan.

§Higher maximums occur but are for unimportant production in Szechwan and Shansi.

Total yearly production is subject to variation, above or below, of about 100,000 tons, owing to variable weather conditions. Variation is primarily in coastal works. Refined salt sold has been included as crude salt produced.

THE PORT OF TIENTSIN AND ITS PROBLEMS

Margaret A. Hitch

"THE harbour and the upper reaches of the Haiho rapidly silted up and the port was closed to sea-going vessels by the middle of June." From the latest (1933) report of the Maritime Customs to the earliest, the navigational problems of the port of Tientsin have called for attention. For Tientsin is an important port, the leading port of North China; with only two southern ports, Shanghai and Hongkong, surpassing it in value of either their foreign trade or their total trade.[1] The greatness of the port lies, in fact, in the sources whence the navigational difficulties arise; for Tientsin, 35 miles from the head of the Gulf of Chihli, offers the nearest sea outlet for the North China plain with its abundant harvests and its silt-laden rivers. The more important waterways of North China, excluding the Hwang Ho but including the Grand Canal, focus on Tientsin. Its tributary territory stretches out to the Mongolian plateau and included part of Manchuria until the present alienation of the province of Jehol, an event "likely to have a permanent effect on the prosperity of Tientsin."

Under stress of military disturbances in recent years, part of the trade from the northern part of the area has been diverted from Tientsin. It is estimated that the port lost four-fifths of its normal wool trade in 1926 for this reason. Influences have been active, too, in an endeavor to divert Mongolian products from the Kalgan-Tientsin route to that of the Chinese Eastern Railway. The area from which most of the trade of Tientsin comes is about equal in size to the United States east of the Mississippi River.

From its early days as a treaty port raw cotton has figured as a principal export of Tientsin, and it still continues to head the export list. Wool, another important staple, had dropped to fourth place by 1931, but it gained in 1933 and nearly offset the loss in cotton in that year. Wool comes chiefly from Kansu and Mongolia. Other important exports are hides and skins, also in large part from Mongolia; eggs and egg products, beans, tobacco, and walnuts from the plain; bristles from northern Hopei and Manchuria; and carpets and rugs manufactured in Tientsin.[2] The commercial status of Tientsin gives it advantages in the trend from the household type of manufacturing to the factory, and already the city has important rayon and cotton-weaving establishments as well as carpet factories.[3]

A careful analysis of the import trade in cotton piece goods is

[1] *The Trade of China, 1933*, Vol. I, Report. China, The Maritime Customs (I.—Statistical Ser.: No. 1), Shanghai, 1934. See especially pp. 5–6.

[2] H. D. Fong: Tientsin Carpet Industry, *Nankai Univ. Committee on Social and Econ. Research, Industry Ser., Bull. No. 1*, Tientsin, 1929.

[3] *Ibid.*: also "Rayon and Cotton Weaving in Tientsin," *ibid., Industry Ser. B-2*, 1930.

included in the earliest reports of the Maritime Customs. Today this item is still the one of greatest value in foreign imports, though Japan has taken the place of the United Kingdom as the principal source of supply. Other important imports include rayon, cotton yarn, and raw cotton—largely of finer grade from India—for manufacture. Kerosene comes from California; machinery—important groups are

FIG. 1—Scene along the bund in Tientsin. (Photograph by courtesy of the U. S. Bureau of Plant Industry.)

textile and electrical—from Germany, the United Kingdom, the United States, and Japan. Food imports come largely from other parts of China; the refineries of Japan furnish sugar.

Since Tientsin was opened as a treaty port in 1861 its trade has grown almost continuously. For some ten or fifteen years before the World War this trade increased markedly, and its volume was augmented still further during the war. Measured in haikwan taels, trade returns showed a drop after the war followed by an almost constant increase; in terms of American money, however, 1919 was the peak year, though 1926 was not far behind. In the last three years, Tientsin, in common with the rest of the world and with the addition of the Manchurian difficulties, has suffered a sharp decline in trade.

With political conditions, price of silver, character of harvests, with all the factors that affect the trade of the port for a given year, must be included the state of the port facilities. Here the port has a perpetual problem. "The eternal struggle of the enterprising merchants, foreign and native alike, of Tientsin can only be compared to the fight of the farmers of the province against the forces of nature, both having the same problem to solve."[4]

[4] H. B. Morse: The Trade and Administration of China, revised edit., London, New York, etc., 1921, pp. 234–235.

The Flood Problem

The great plain of North China, practically flat for long distances, is both the result of floods and a contributing factor in their recurrence. Rivers, draining a region of more than 88,000 square miles around Tientsin, converge at that city (Fig. 7) to form the Hai Ho.[5]

Fig. 2—River scene on the Hai Ho, Tientsin. (Photograph by courtesy of the U. S. Bureau of Plant Industry.)

Once they have left the loess hills to the west, these rivers meander across the plain made of their own deposits, being kept in their courses chiefly by old earthen dikes that frequently break under the stress of high water. So level is the plain that, with the surface waters in the form of immobile ice for some months each year, two or three years are commonly required for floodwater to reach the sea.

The rainfall regime of Tientsin itself may be taken as roughly representative of that of North China as a whole. The mean annual precipitation for a 35-year period is 20 inches (maximum, 31.3 inches; minimum, 10 inches); 73 per cent falls in the period June, July, and August.[6] Variation is great in both the amount of rainfall and the time of greatest intensity, and it is greater for the interior highlands than for the plains. The early advent of summer rains in 1933, for instance, brought disastrous results to the region about Tientsin.

Ordinarily the amount of water in the streams converging on Tientsin is not great: indeed, it is too little at times to permit the ready movement of the shallow-draft native sampans and junks. Before the rainy season the Yung Ting Ho is a mere creek two or three feet in depth (Fig. 8). But in the rainy season the volume is

[5] W. H. Mallory: China: Land of Famine, *Amer. Geogr. Soc. Special Publ. No. 6*, 1926, p. 53.
[6] B. B. Chapman: The Climatic Regions of China, *Univ. of Nanking College of Agriculture and Forestry Bull. No. 3 (N.S.)*, 1933.

increased greatly, and when heavy rains occur simultaneously over the entire watershed the Hai Ho is unable to carry the water off to the sea, and the land is inundated. From recent records it appears that the region is subject to floods every six or seven years on the average. Certain areas are flooded every year so that no effort is made to cultivate them. During the flood of 1917 portions of the foreign concession at Tientsin itself were under water. The flood of 1924 again threatened Tientsin, inundated some 11,500 square miles of land, and totally destroyed the crops on 8800 square miles. About one and a half million people were driven from their homes, great damage was done, trade disrupted, and the purchasing power of the people enormously reduced. Thus are the problems of flood control and port development interlocked.

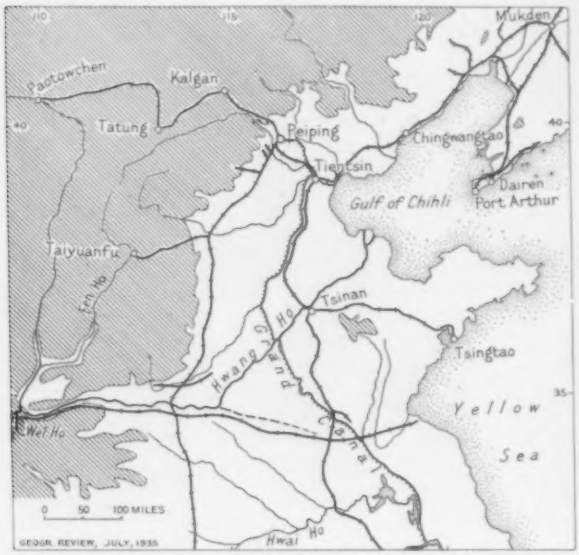


FIG. 3—Sketch map illustrating the situation of Tientsin on the North China plain and its relation to the main waterways and railroads. The shaded area is over 400 meters in altitude. Scale 1 : 15,000,000.

TRADE OF THE PORT

Tientsin was poorly endowed by nature as a port site, and it has been only by constant improvement that the growing trade has been accommodated. The port has been handicapped because its outlet to the sea is a narrow, tortuous, silt-laden stream, at various times in dangerous flood, in exceedingly low water, or ice-bound, at whose mouth the wind-driven waves pile up the ocean sand and river silt in a bar some five miles in width (Fig. 4). The favorable situation with reference to the regions served, however, has outweighed these disadvantages. There are better natural harbors on the sunken coasts of the Liaotung and Shantung peninsulas; Chinwangtao on the extreme northeastern edge of the North China Plain has a better harbor. But because of the distance to these ports from the larger part of Tientsin's tributary area they do not handle much of the trade. They do compete with Tientsin, however, for trade in those

sections of the area relatively near them—Chinwangtao, Newchwang, Dairen, and even Vladivostok to some extent, on the northeast; Kiaochow and Chefoo on the southeast.[7] Table I (p. 372) gives the value of the trade of the port.

Periodically there is under discussion a project for the establishment of a "Great-Northern-Port" for China on the coast between

FIG. 4—The Hai Ho, showing the course of the river between Tientsin and the Po Hai (Gulf of Chihli), with its original bends and subsequent cuttings. Scale approximately 12 miles to an inch. (Reduced from U. S. Hydrographic Office Chart 3229.)

Taku and Chinwangtao, the latest site favored being just east of the Ta Ching Ho estuary.[8] Undoubtedly the cost of such a development must defer the materialization of the project, even if it should eventually win favor. The renewed consideration, however, for which there now exists a commission under China's Ministry of Communications and Ministry of Railways, perhaps is serving as a spur to efforts for the solution of Tientsin's port problems, with a hope of bringing the establishment and maintenance of the facilities so badly needed.

Since the depth of water in the Hai Ho, even at high tide, will not accommodate all the vessels trading with this leading port of North China, it has been necessary to develop additional trade facilities near the mouth of the river. Tangku, on the north bank and a few miles from the mouth, may be called an auxiliary port of Tientsin. The Peiping-Mukden Railway passes through Tangku and by means of several spurs provides direct connection between the wharves and Tientsin. Tangku is well supplied with private wharves and godowns and has two dry docks and coaling facilities. Except in seasons of unusually heavy silting in the harbor and river, this port accommodates vessels of practically no deeper draft than Tientsin itself does, owing

[7] P. P. Whitham: Transportation Development in China, U. S. Department of Commerce, Peking, 1919, pp. 51–53.

[8] Shu-t'ien Li: The Present Status of the Site of the Great-Northern-Port, *Journ. Assn. of Chinese & American Engineers*, Vol. 14, No. 3, 1933, pp. 1–20; reference on p. 1.

to the depth on the bar that vessels to Tientsin and Tangku alike must cross; but it is available to those vessels that do not care to make the difficult trip upstream and during periods when severe freezing interrupts the river traffic.

The accompanying table (p. 373) gives for a number of years the record draft of vessels reaching Tientsin. The all-time record was

TABLE I—VALUE OF THE TRADE OF TIENTSIN

(*In 1000 Haikwan Taels*)

YEAR		IMPORTS	EXPORTS	TOTAL	VALUE OF TAEL GOLD $
	F*	54,038	3,182	57,220	
1910	C	22,467	21,836	44,303	0.66
	T	76,505	25,018	101,523	
	F	71,622	7,620	79,242	
1913	C	25,567	30,209	55,776	0.73
	T	97,189	37,829	135,018	
	F	59,804	20,100	79,904	
1916	C	28,423	28,610	57,033	0.79
	T	88,227	48,710	136,937	
	F	86,741	27,471	114,212	
1919	C	33,191	44,079	77,270	1.39
	T	119,932	71,550	191,482	
	F	125,927	45,970	171,897	
1922	C	47,827	29,092	76,919	0.83
	T	173,754	75,061	248,816	
	F	110,310	61,704	172,014	
1925	C	80,979	38,234	119,213	0.84
	T	191,289	99,938	291,227	
	F	139,485	81,051	220,536	
1928	C	99,872	32,608	132,480	0.71
	T	239,357	113,659	353,016	
	F	137,388	87,902	225,290	
1931	C	83,833	45,062	128,895	0.34
	T	221,221	132,964	354,185	
	F	77,521	56,786	134,307	
1933	C	71,523	43,589	115,112	0.33
	T	149,044	100,375	249,419	

*Figures, 1910–1931, marked F, same as at present; figures, 1933, marked F give value of direct foreign trade; those marked C give the value of Chinese produce, including re-exports; figures marked T show total of these values.

18 feet 3 inches in 1925, the usual accommodation being much less than this.

The Hai Ho Conservancy Board

The Hai Ho Conservancy Board, charged with the improvement of the river, was established by the Peace Protocol in 1900. One of the Board's objectives has been to straighten the tortuous channel

Table II—Arrival of Vessels: Port of Tientsin

Year	Arriving at Bar	Crossing Bar	Arriving at Tientsin Bund		Record Draft to Tientsin
			Total	Draft 13 Feet +	
1898	.....	.....	0	.....	.....
1899	.....	.....	2	.....	.....
1900	.....	.....	4	.....	.....
1901	.....	.....	15	.....	.....
1902	.....	.....	134	.....	.....
1903	.....	.....	333	.....	11′8″
1904	707	.....	374	.....	11′9″
1905	795	.....	395	.....	11′7″
1906	1,017	.....	444	.....	.....
1907	856	.....	513	.....	13′6″
1908	788	.....	511	.....	13′6″
1909	1,006	.....	623	3	13′6″
1910	992	.....	607	9	.....
1911	1,198	.....	698	20	14′0″
1912	943	654	620	5	13′9″
1913	1,001	731	703	16	14′0″
1914	1,147	831	814	44	14′8″
1915	982	790	768	84	15′6″
1916	866	696	658	73	14′8″
1917	742	555	473	11	13′6″
1918	759	575	529	29	14′3″
1919	1,024	855	747	90	15′6″
1920	1,154	1,041	1,002	284	16′11″
1921	1,415	1,275	1,231	461	16′3″
1922	1,370	1,223	1,172	550	16′9″ *
1923	1,447	1,288	1,269	755	16′10″
1924	1,502	1,337	1,311	794	17′6″
1925	1,896	1,711	1,702	1,100	18′3″
1926	1,889	1,702	1,665	994	17′11″
1927	1,701	1,503	1,235	361	17′4″
1928	2,031	1,791	668	0	13′0″ †
1929	1,878	1,615	544	6	14′6″ †
1930	1,781	1,556	1,460	528	.....
1931	1,835	1,625	802	116	15′0″ §
1932	2,149	1,934	382	18	13′5″ §
1933	2,303	2,061	1,008	139	14′3″

*Record up; record down, 17′ 4″. †Limited depth in harbor. §Greatest depth recorded at Tientsin.

to the sea. Five cuttings in the river below Tientsin have eliminated some of the largest bends while shortening the river distance between Tientsin and the sea from 56 to 35 miles and have improved the current by increasing its scour and decreasing its tendency to deposit silt (Fig. 4). Two more cuttings farther down the river have been proposed. At Tientsin in the native city two cuttings have been

FIG. 5—A load of walnuts on the Tientsin bund. (Photograph by courtesy of the U. S. Bureau of Plant Industry.)

made near the junction of the Grand Canal, the Hsi Ho, and the Pei Ho where there are some difficult bends. One of these, the Cathedral Cutting, so improved the flow of water that the daily range of the tide just above the cutting was increased from 3.64 feet to 5.56 feet and the depth of water in the Tientsin anchorage was increased some two feet. The limitation on the length of boats that can round the bends and swing for the return trip, has been lessened to some extent by the cuttings. Widenings of the river at Tientsin have produced, in effect, two swinging berths, or turning basins. The length of vessel that now can swing at Tientsin is 325 feet, but it has been proposed to enlarge one of the swinging berths to accommodate vessels up to 350 feet in length.

In 1911 observations on ice conditions were begun to ascertain whether it would be feasible to keep any part of the Hai Ho open and thus keep the trade of Tangku, if not of Tientsin, uninterrupted through the winter.[9] Reports were favorable, and two icebreakers were accordingly purchased for operation the following season. Subsequent experience has shown that in normal winters the bund at Tientsin can be made accessible to vessels without serious interruption but that in unusually severe winters only Tangku can be kept

[9] Great Britain: Trade of Tientsin, 1911, *Diplomatic and Consular Repts., Ann. Ser. No. 4902*; China, Accounts and Paper, 1912–13, Vol. 94, p. 7.

open. The elimination of more of the bends where ice tends to collect will be of aid in clearing the river of this obstruction. A dike extending for some 6000 feet along the north flats at the mouth of the river has been constructed at a cost of $25,000[10] to prevent the ice that forms on the flats from being carried into the river either by the tide or by strong east or northeast winds.[11] The winter of 1930–1931 was

FIG. 6—A caravan of 42 wool-carrying camels from Kansu. They have been 27 days en route and are 2 days from their destination, Yutze, a railway station in Shansi. (Photograph by courtesy of the U. S. Bureau of Plant Industry.)

probably the severest ice season in the history of Tientsin shipping. Early in February a northeast gale set in, followed by continuous easterly winds. These brought an enormous amount of drift ice to the bar, and an ice field formed that extended 70 miles out to sea. The ice piled up to 10 feet in thickness. Three large icebreakers worked in the channel, and ships could move only in convoy. After more than two weeks a change of wind cleared the ice away in a few days. Despite the severity of the winter, however, more ships are shown to have crossed the bar during this ice season than during the previous one.

Plans for the improvement at the mouth of the river included the cutting of a new dike-enclosed channel through the bar to allow ships drawing 20 feet to cross at high tide. Work was begun in 1924. Dikes measuring 33,000 feet in length were completed in 1927, and dredging was in operation. However, difficulties of execution increased to such an extent that a halt was called to consider the project anew. The accumulation of silt on the flats through which the channel was to run, the return of silt to the channel by wave action, and the weakening of the wooden structure of the dikes by sea borers (teredos) were factors

[10] Special Report of Assistant Trade Commissioner, Tientsin, Jan. 31, 1931, in the files of the U. S. Department of Commerce, Washington, D. C.

[11] *Ann. Rept. Hai Ho Conservancy Commission*, 1932.

in bringing about a decision to abandon the project. Operations since have been directed toward the improvement of the old channel.

Silting the Basic Problem

The gravest problem of the port is this matter of silting. The spring and summer floodwaters of the Yung Ting Ho bring most of the silt to the Hai Ho. The drainage area of this stream covers some 22,000 square miles, a large part of which is in the loess, and, owing partly to the precipitous nature of the hills and partly to the lack of trees and other vegetative covering, erosion is excessive. It has been estimated that the time required for the removal of one foot from the basin of the Yung Ting Ho is 840 years as compared with 940 years for the Hwang Ho and more than 4000 years for the Mississippi.[12] The maximum recorded silt load of the river is 38 per cent by weight. From two topographic surveys made in 1921 and 1927 in the delta of the Yung Ting Ho and on river-bed and flood-plain deposits it has been estimated that the Yung Ting Ho carries annually from 27 to 30 million cubic meters of silt.[13]

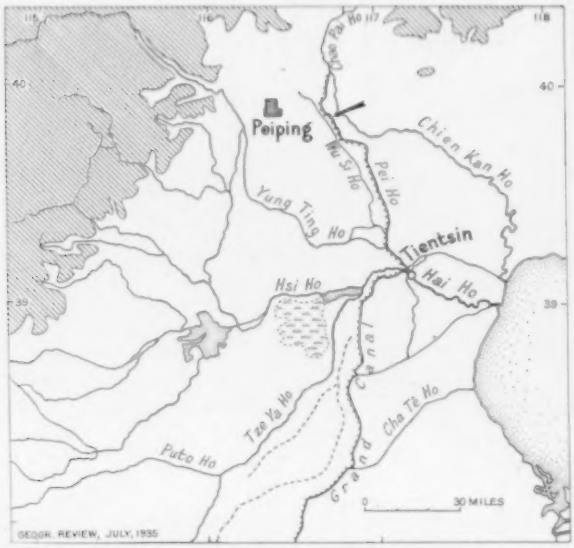


FIG. 7—Sketch map showing the principal rivers converging on Tientsin to form the Hai Ho, their only outlet to the sea (after the Atlas of China, edited by V. K. Ting and W. H. Wong of the National Geological Survey, Peiping, and published by the Shun Pao Press, Shanghai, 1934). The arrow indicates the region in which the Chao Pai Ho broke its banks and its waters found an outlet through the Chien Kan Ho. Scale 1 : 3,800,000.

Viceroy Li Hung Chang, some fifty years ago, attempted to divert this floodwater from Tientsin. The several canals constructed were satisfactory in that they provided additional runways for the floodwaters. They also increased opportunities for inland navigation; but they played havoc with the navigation of the port, for they carried

[12] W. H. Wong: Sediments of the North China Rivers and Their Geological Significance, *Bull. Geol. Soc. of China*, Vol. 10, 1931, pp. 247–271; reference on pp. 252 and 253.

[13] Shih-ta Hsu and Shu-t'ien Li: The Radical Improvement Scheme for the Yung Ting Ho, *Journ. Assn. of Chinese & American Engineers*, Vol. 15, 1934, No. 2, pp. 22–34, and No. 3, pp. 12–25; reference in No. 2, p. 32.

so much of the water of the Pei Ho to the Paitang Ho that the level of the Hai Ho was lowered and its current lessened. This decreased its scouring ability and increased the opportunity for the deposition of silt. Fewer and fewer vessels risked coming up the river; in 1898 not one vessel came to Tientsin, and in 1899 only two came (p. 373). One of the first acts of the Conservancy Board was to close three of the largest of these canals with locks and thus restore to the Hai Ho its greater volume.

FIG. 8—The Yung Ting Ho, northwest of Peiping. Next to the Yellow River this stream is the greatest contributor to the flood troubles of North China. Before the rainy season the stream has a depth of only 2 or 3 feet. (Photograph by courtesy of the U. S. Bureau of Plant Industry.)

Since that time dredging has been carried on assiduously, in an effort to remove the annual deposits and, further, to increase the depth of the river. Additional dredging in the harbor has been necessary, since ships have increased in size and all but very shallow-draft boats must take advantage of high tide both in crossing the bar and in coming up the river.

Dredging in the harbor, however, has attendant dangers. Special precautions have had to be taken to protect the banks from being undermined. In years of exceptionally high floods much ground is lost. During the summer flood of 1931 as much as 400,000 fang[14] of silt, according to estimates, was deposited in the harbor in the course of 24 hours, while the daily output of the dredging plant was only 800 fang. The bed of the river was raised 5½ feet in a few days.[15] After the floods of 1917 the depth of water on the Taku bar was found to be 2.5 feet at ordinary low water, whereas before the floods it was 9 feet. A deposit of 9 feet of silt in 48 hours is recorded. Thus the results of the dredging of a season may be wiped out in a few hours.

[14] A fang of earth measures 10 feet square and 1 foot thick.

[15] *Ann. Rept. Hai Ho Conservancy Commission*, 1931.

For some years before March, 1927, a satisfactory depth of the river had been maintained for at least a part of each year (p. 373). On the twenty-second of that month a steamer drawing 17 feet 6 inches reached Tientsin without difficulty. Then came the spring freshet of the Yung Ting Ho carrying an unusual amount of silt, which reduced the channel depth to 12 feet in a few days. In 1928 silting continued to gain on scouring plus dredging, and in July of that year—the time of the summer flood—official notice was issued that no coasting vessel entering the river should proceed above Tangku. In November the channel was opened to a depth of 10 feet, but it was almost another year—October, 1929—before vessels drawing 13 feet could reach Tientsin. Immediately after the next spring freshet the depth was reduced to 8 feet.

The Palliative Scheme

Various plans have been proposed in the last few years to provide a permanent remedy for both flood and silt problems. However, as the need for immediate relief is urgent, a temporary "palliative scheme" has been brought into operation.

Under this scheme (Fig. 9) a barrage, or regulator, has been built across the Pei Ho immediately below the point where it is joined by the Yung Ting Ho, while just above the regulator a channel 200 meters wide has been cut from the Pei Ho eastward through the embankment of the Peiping-Liaoning Railway to a settling basin. A channel for routing the clear water back to the Hai Ho is to lead from the southwest corner of the settling basin to the lower Pei Ho. As this outlet will be on the same side of the basin as the inlet for silty water and relatively near it, a partition dike is to be built. According to the last reports available, this channel and dike had not yet been completed.[16] From the southeast corner of the settling basin an outlet channel to the Chin Chung Ho has been constructed which, until the southwestern outlet is completed, provides the only means of egress for the clear water. The land flooded by diversion of the freshets to the settling basin is private property, and it is important that it be kept under water only a short time.

To protect the homes of the people living in the settling basin, dikes have been built around its 18 villages. A dike 18.7 kilometers in length extends across the southern edge of the basin and keeps the water within the basin on the low side. The top height of these dikes is 6 meters, Taku Datum, and their earthwork measures 1,642,000 cubic meters. Intakes and drainage culverts are arranged in the village dikes for the convenience of the villagers.

[16] C. Y. Kao and J. Chang: The Hai Ho Palliative Scheme, *Journ. Assn. of Chinese & American Engineers*, Vol. 14, No. 2, 1933, pp. 14–23; reference on p. 23.

The first diversion of floodwaters to the settling basin was that of the summer flood that began on the night of June 30, 1932. According to plans made by the committee in charge of operations, diversion was scheduled to take place when the joint waters of the Yung Ting Ho and the Pei Ho carried as much as 10,000 cubic meters of silt a day or when the water level of the Yung Ting Ho at Lukouchiao reached 61 meters, Taku Datum. On the morning of July 1 the silt content of the Yung Ting Ho was found to be 6 per cent and the rate of discharge 145 cubic meters a second. Diversion was begun. On July 6, its burden of silt having been dropped, the clear water began to reach the outlet leading to the Chin Chung Ho.

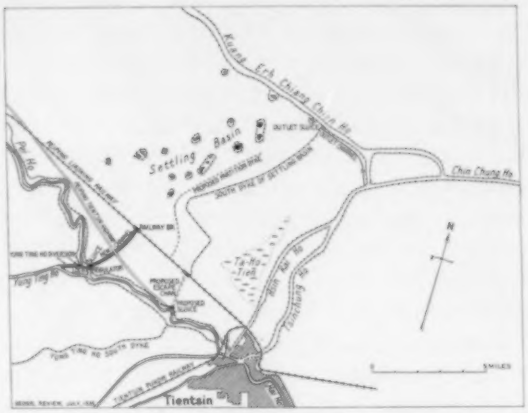


FIG. 9—Sketch map of the Palliative Scheme, showing location of dikes and channels. After sketch maps of the Hai Ho Conservancy Board (see footnote 16).

Unfortunately a large amount of clear water was diverted unnecessarily with the silty water, so that the basin became filled before it had accommodated all the silt-laden flood of the Yung Ting Ho. It became necessary, therefore, to revert the remainder of this flood to its old route through the Hai Ho. The harbor, which had had very little silting during the period of diversion, suddenly received silt deposits four and five feet deep. However, high waters of the tributaries from the south aided in scouring the harbor and carried the silt in the usual wave formation to the sea.

The source of the clear water was the Chao Pai Ho. In 1912 this stream, then a tributary of the Pei Ho, broke its banks east of Peiping and found an outlet to the sea through the Chien Kan Ho (Fig. 7). Its relatively silt-free waters, however, were needed as a diluting agent in the Hai Ho. In 1926 control works were completed by which the waters of the Chao Pai Ho could be directed either to the Pei Ho or to the Chien Kan Ho as there should be need. In this instance the waters should have been directed to the latter instead of the former as actually was done.

From measurements taken of the silt deposited in the basin during the summer floods it is estimated that these deposits amounted to 13,000,000 cubic meters in the dry state. It is estimated further that had the spring flood been diverted an additional deposit of 1,000,000

cubic meters would have been made. Although the height of the protective dikes is 6 meters, Taku Datum, the waters have not been allowed to rise above 4.5 meters. The total capacity of the basin up to this level is given as some 275,000,000 cubic meters, but, since deposition will not be uniform, the full capacity cannot be utilized, and the engineers consider that a deposit of 225,000,000 cubic meters is a reasonable expectation. The life of the settling basin, on the basis of the 1932 floods, would be 16 years.

Although 1933 began encouragingly enough, with early spring soundings showing a depth improvement over the 13 feet of November, troubles soon arose. Diversion was handicapped by objections on the part of the villagers of the settling basin to the flooding of their lands. Then the summer flood came unusually early and was unduly prolonged. The depth lost in the summer was, however, regained in the autumn, and by early November the river once again had a permissible draft of 13 feet. The loss of depth on the bar was restored also, almost entirely.

The silt deposited in the settling basin in 1933 is estimated at 26 million tons, double that of 1932, and shortens the possible life of the basin. The estimate of the silt load of the Yung Ting Ho and the Pei Ho that could not be diverted but was carried into the Hai Ho is 7 million tons, making a total of 33 million tons brought down by the two rivers. Thus it may be assumed that the silting that would have taken place in the river and on the bar in the absence of any diversion would have brought an even more serious situation than the port has ever experienced. On the other hand, observations made during the flood season indicate that no deterioration whatever would have come if the palliative scheme as planned had been in complete and proper operation.

That this is only a palliative scheme, however, must be remembered. It offers, through the present settling basin, a respite of only a decade or two. There are, however, other low areas between this basin and Tientsin and also along the Chin Chung Ho which might be utilized as settling basins and thus prolong the life of the palliative scheme to possibly one hundred years.[17] An unsatisfactory feature is that water routed through the Chin Chung Ho is lost to the Tientsin harbor. These areas are alkaline and sandy and if built up with rich silt of the Yung Ting Ho may be converted into farm land.

Proposed Permanent Solution

The latest of the proposed permanent schemes has been put forth by the engineers of the North China River Commission,[18] who plan

[17] Hsu and Li, *op. cit.*, No. 3, p. 16.
[18] Hsu and Li, *op. cit.*

to extend operations back into the mountains to the source of trouble. They propose to build two large detention dams along the upper course of the Yung Ting Ho at favorable places before the river reaches the plain. Farther back in the mountains, on the two chief streams that unite to form the Yung Ting Ho—the Yang Ho from the Inner Mongolian Plateau and the Sang Kan Ho from the Wu Tai Shan Mountains—a series of check dams are planned, five on one river, six on the other, with additional ones as found desirable. Their purpose is to reduce stream gradient and velocity and thus diminish the amount of silt carried downstream. An improved weir is proposed, at a point below the detention dams, by means of which excessive floodwaters may be diverted to certain streams to the south, whose waters, after a circuitous route advantageous to silt deposition, rejoin those of the Yung Ting Ho just west of Tientsin.

This scheme includes also the reclamation of certain low areas, chiefly alkaline, sandy, or swampy, bordering the Yung Ting Ho, outside its dikes, for a stretch of some 65 kilometers as it crosses the plain. These areas, which lie below the level of the present bed of the river, are to be "silt-depositing districts" and are to be built up gradually into fertile agricultural lands by successive layers of silt deposited on them by the mud-laden waters diverted there by means of sluices in the dikes. It is to be hoped, furthermore, that a broad reforestation program will be included in the executed plan.

Tientsin, since its rich tributary region was opened to foreign trade, has struggled through numerous and serious difficulties to serve it as the connecting link with the outside world. Repeated disaster—almost defeat—has been met. If present plans can be perfected in detail and operation, Tientsin may become a truly great port, and a major factor contributing to its greatness will be the increased prosperity that the plans for its own life will bring in turn to North China.

THE FINLAND COMMUNITY, MINNESOTA*

Darrell H. Davis
University of Minnesota

THIS is the story of a submarginal agricultural area in the "Arrowhead Country" of northeastern Minnesota. As conditions are typical of those in cutover lands with rapidly growing tax-delinquent acreages in this part of the state, it illustrates the problems of all such areas.

Settlement began in 1895 with a nucleus of Finnish families. Their numbers increased until today the occupants of the farms, most of which were taken up as homesteads before 1906, are practically all Finns. Members of other racial groups, constituting but a small fraction of the present population, arrived later, and few of them are dependent on agriculture.

Limits and Relationships of the Community

The Finland Community is a closely integrated economic as well as geographic unit, attenuated in form, with settlement confined to two major axes parallel to the main north-south and east-west highways. The early occupance pattern was determined neither by rail lines nor by the present highway system, for settlement preceded the construction of both. The first arrivals "packed in" over "trails" from the boat landings at and between Beaver Bay and Little Marais; but, as the more desirable agricultural land was generally located where topographic conditions favored road building at a later date, most of the early farms were either on or near the present highways. The occupance pattern has been further accentuated by the abandonment of clearings on secondary roads impassable much of the year. The establishment of definite limits for the community is possible, since transition zones are either largely or totally unoccupied. The boundary is most indefinite to the south, where the Beaver Bay and Finland communities join near Lax Lake in an area occupied by four families; elsewhere two to eight-mile breaks in settlement occur.

Two satellite communities are dependent on Finland: Cramer, fourteen miles to the north, a small group trading at Finland in part and sending children to the Finland school; and Isabella, about eighteen miles to the northwest, maintaining its own school but doing practically all trading at the Finland stores. Finland, in turn, is itself similarly related to Two Harbors and, to a lesser degree, to Duluth.

*This study of the Finland Community, based on field work during the summer of 1934, was undertaken primarily to demonstrate the value of intensive studies as the basis of plans for the utilization of the cutover lands of northeastern Minnesota. To be of practical value, definite programs for specific areas are essential.

these two cities serving as the chief contacts with the outside world by way of the Beaver Bay Road.

COMMUNICATION

Two main highways serve the Finland Community today. One, the Beaver Bay–Cramer Road, is a part of the inland portion of the old main highway from Duluth to the Canadian border, shorn of its former advantage by the opening of the present shore road in 1924. A second road runs from Little Marais to Ely. This will be supplemented shortly by the Ilgen City cut-off, which will displace the Little Marais Road as part of State Highway Number One (Fig. 1). Both roads are graveled, maintained in fair to good condition, and passable at all seasons of the year except for a short period in the spring when the frost goes out of the ground. This time when the roads "break up" regulates the occurrence of a movable vacation in the school year.

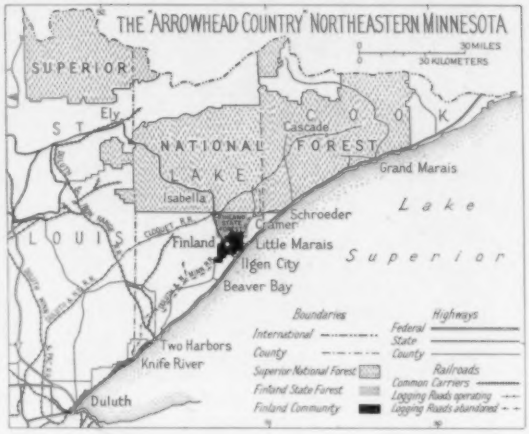


FIG. 1—Map of the "Arrowhead Country" of northeastern Minnesota. Scale 1 : 3,300,000.

These two highways at present afford the only means of communication with other parts of the state; for boat lines no longer operate between the landings on the north shore of Lake Superior and no rail lines serve the area. In addition to the main highways, there are about ten miles of secondary roads, exclusive of private roads and roads constructed and kept in condition by the Forest Service, maintained in passable condition during the summer and more or less usable the rest of the year. Most of these roads do not serve more than two or three farms; several serve only one; and the cost of maintenance, considering the extent of their use, is absurdly high. Farms on such roads are being gradually abandoned because of their inaccessibility; on at least three roads abandonment has been complete.

For a short period rail service was afforded by the Duluth and Northern Minnesota Railroad, a logging road built from Knife River on Lake Superior to Cascade. Construction was begun in 1898; the road reached Finland in 1911—it was then that the community acquired its name—and was completed to Cascade in 1915. When

it was proposed to discontinue service in 1921, with the exhaustion of the commercially exploitable timber, the case was bitterly contested in the state courts, but the decision was favorable to the railroad company, and today all that remains to mark the location of the former rail line are piles of rotting tamarack ties, an occasional stretch of the old roadbed, and the former section house at Finland, now used as a dwelling place.

FIG. 2—The John Haveri farm and farmstead on the Baptism River, one-half mile south of Finland (C on Fig. 4). Barns and ladder at left; bathhouse at extreme right. The cultivated fields border the stream; the cleared slope in the foreground is too stony to be used except for pasture; in the background the uncleared upland extends for miles without habitation. This and the following photographs were taken September, 1934.

During the few years of its operation the railroad served the transportation needs of the Finland Community effectively; further, it supplied a market for logs at fair prices and thus furnished the farmers with a supplementary source of income. The present rail line, the Cloquet Railroad, ten miles to the northwest of Finland, is a private road and furnishes neither an outlet for agricultural surpluses nor a market for logs.

Although the new Beaver Bay–Cramer Road is much better than the older highway that it displaced, particularly where it follows the route of the abandoned rail line, and although the completion of the Ilgen City cutoff will still further improve conditions, lack of rail communication works a serious hardship, since it necessitates trucking all produce to Two Harbors, thirty-nine miles from Finland, over a heavy grade from the Lake Superior lowland to the uplands, which rise nine hundred feet within a distance of less than two miles.

THE FOREST RESOURCE AND LUMBERING OPERATIONS

Early lumbering operations north of Lake Superior were confined to a narrow strip along the shore; not until the construction of the Duluth and Northern Minnesota Railroad were logs cut in the

Finland area. The logs were shipped by rail to Knife River; from here the white pine and cedar went to Duluth to be sawed into lumber, the balsam and spruce to Ashland, Wis., for the manufacture of pulp; the tamarack was used for railroad ties.

After these lumbering operations were completed much merchantable timber, as well as small growth, particularly on private holdings, was destroyed by uncontrolled fires resulting from the

FIG. 3—The John Waxlax farmstead, six miles southwest of Finland, with Lax Lake in the distance (D on Fig. 4). The building at the right is a combined store and residence; the log house is the old family home, one of the first buildings in the community. Across the lake, to the east, the forested upland is unoccupied for miles.

careless burning of slash. The entire area was burned over in 1908, 1909, and 1910, and portions suffered from fires in 1923 and 1926. The ever present fire hazard is suggested by the ladders often attached to the roofs of the farmhouses and barns as an aid in fire fighting (see Figs. 2, 3, and 9).

The present stand of timber consists of mixed hardwoods and conifers of both upland and swamp varieties, including maple, white birch, aspen, cedar, spruce, balsam, white pine, and several types of brush, all in various stages of reproduction. Most of the merchantable timber has been either removed by cutting or destroyed by fire, but some still remains, particularly to the north of Finland. The establishment of the Finland State Forest, which at present includes only a portion of the Community, has been of much benefit in regulating unauthorized cutting on both public and private land and in the prevention and control of fires. It is hoped that its limits may be extended, eventually to absorb the entire area.

NUMBER AND COMPOSITION OF THE POPULATION

The present population of the Community fluctuates somewhat but normally is about 160. During periods when the cities offer opportunity the younger members of the families leave; when unem-

ployment occurs they return to the farms. The summer season affords employment at the numerous lake-shore resorts, particularly for the female element.

Peripherally, the population is Scandinavian, with Swedes in the majority, but near Finland and especially along the Little Marais-Isabella Road there are few on the farms except Finns. In Finland proper there are a number of more recent arrivals of other nationalities, some only temporary residents.

The population is characterized by an excessive percentage in the older age groups. Of the total population, 13 per cent are more than 65 years of age and an additional 12 per cent between 45 and 65; only 16 per cent are in the age group 15–24. This reflects the lack of opportunity in the area and is a material change in population composition from that of the comparatively recent past, as school enrollment

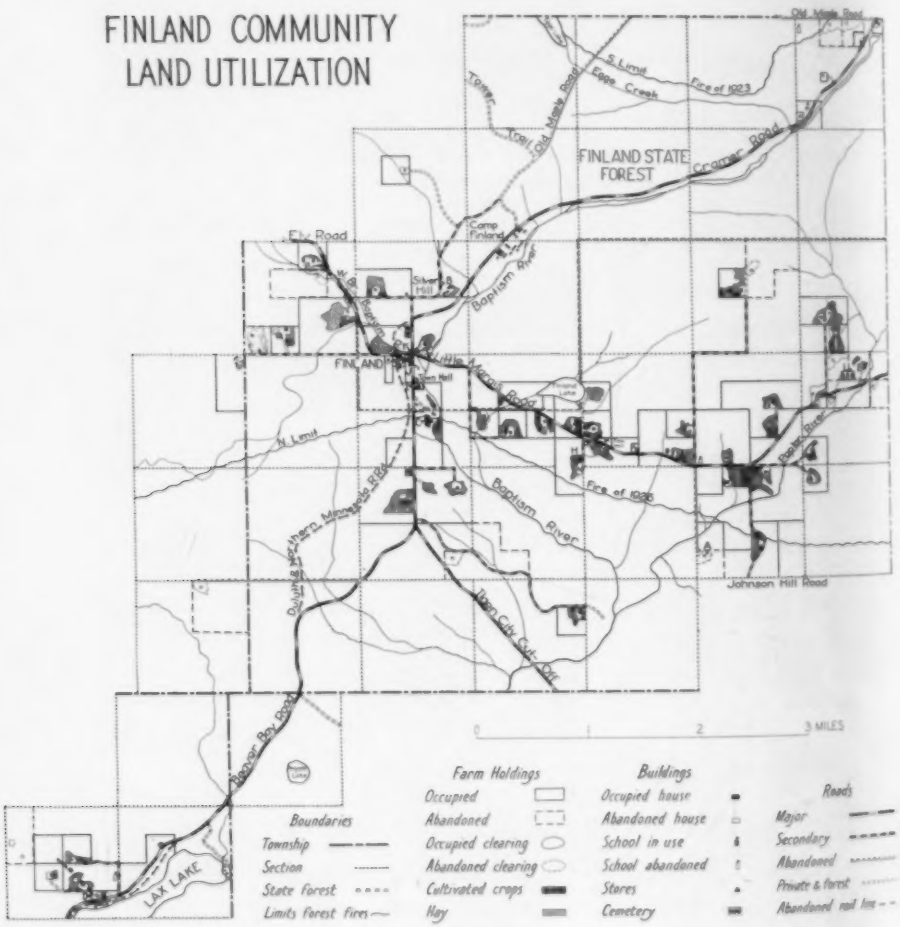


FIG. 4—Land utilization.

indicates. Originally the Community was served by four schools with a total enrollment of about 75 children; today one school at Finland with an enrollment of 29 serves the entire Community. Of this number 10 come from Cramer; only 10 families from the Finland Community contribute children.

In such an isolated area, populated by a group of essentially homogeneous racial extraction, it is not surprising to find a high degree of interrelationship: in some cases a single family is related by blood or through marriage to 25 per cent or more of the total population. A striking characteristic of the composition of the population is the ratio of males to females—130:100. Out of a total of 61 occupied houses 22 are occupied by men living alone or with other men. The Finland Community represents an eddy or backwater in which misfits from other areas have accumulated. Some are former workers in the

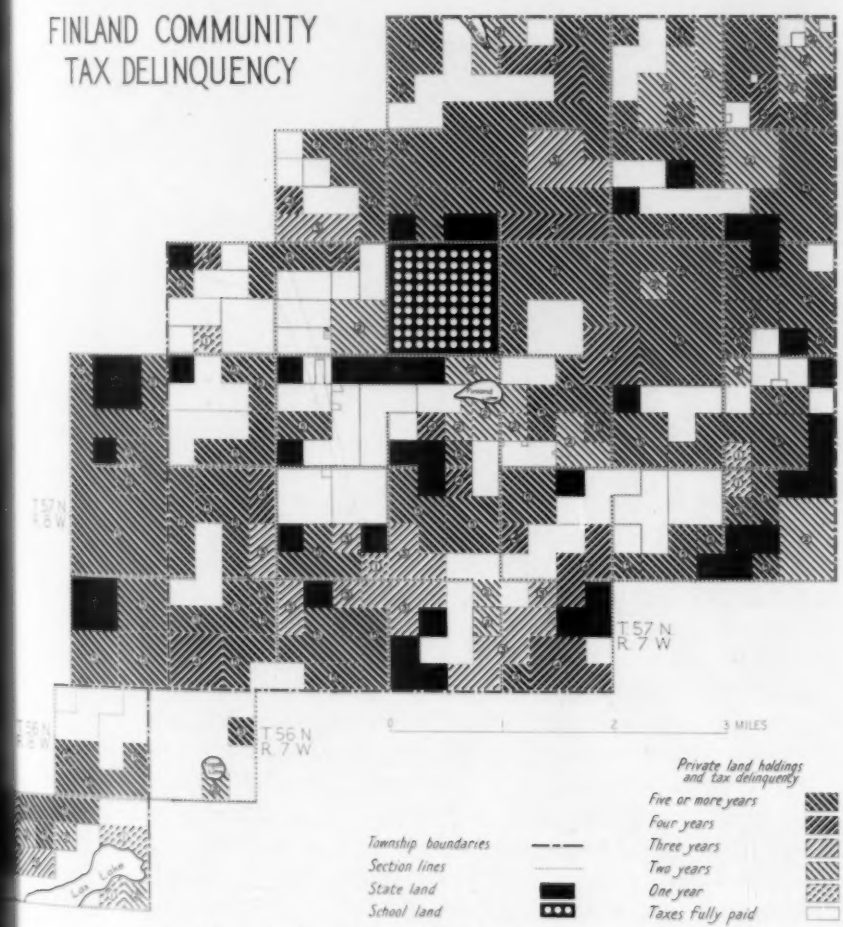


FIG. 5—Land ownership and tax delinquency.

lumber camps; others have moved in from the larger cities. Life is very simple, a type of subsistence existence. As one individual, formerly from one of the large cities of the state, expressed it: "If all else fails, one can always make a living from the woods." In many respects the Community represents a preservation of a frontier. In reality the area embraced by the Community is a frontier region agriculturally, and such it will always remain.

FIG. 6—The "Old Silver Road" just east of "Silver Hill," looking north (B on Fig. 4). A typical secondary road serving only one farm.

LANDHOLDINGS AND FARM LAND

The Finland Community is an area of 24,320 acres in 235 separate tracts owned by 179 individuals and corporations, including the state, the largest single owner, which has 2000 acres in 24 separate parcels—8.2 per cent of the total area, or, including 640 acres of school land, 10.8 per cent (see Fig. 5). Three other large holdings total 3800 acres, or 15.6 per cent of the areal extent of the Community. These, together with several other large holdings of smaller size that constitute in all 33 per cent of the total area, generally represent land still owned by lumber companies, land taken in payment of debt, or land acquired as a basis for selling stock in companies organized ostensibly for the breeding of fur-bearing animals. Of the total area only 3966 acres are occupied, mostly included in 40 farms. The average farm is thus about 100 acres, of which about 20 acres are cleared. Clearings represent less than 3 per cent of the total area of the Community. They are seldom rectangular (Fig. 4); everywhere tongues of forest seem to invade the land in use: the significant landscape fact is the forest, not the clearing. Out of a total of 48 clearings in the Community, 8 were abandoned between 1905 and 1934; and only 1 new clearing has been made recently. On some of the farms still occupied the clearings are not used except for the wild hay that they supply. Agriculture is definitely on the downgrade.

Occupied farms and clearings are concentrated on or near the main roads, particularly the east-west highway. Of clearings more than a quarter of a mile off such roads, nearly half are now abandoned, and many others are tax delinquent for such extended periods of time that their continued occupation is improbable. These earlier clearings were made before good roads were in existence and automobiles in common use. Today parctically all the farmers own cars.

FIG. 7—Boulders in the Baptism River where the stream cuts through excessively stony soil (E on Fig. 4). One quarter of a mile east of Finland, north of the Little Marais Road.

Upland soils are excessively stony and in many places are entirely lacking or so thin that agricultural use of the land is impossible. This has concentrated the clearings in the depressions. Wherever uplands are in use, and even on the lower land, many fields are so stony that no attempt is made to use them except for pasture (Fig. 2). The excessively stony upland farms, mostly at some distance from main highways, are in the process of gradual abandonment; everywhere agriculture is going downhill, both literally and figuratively.

THE AGRICULTURAL ECONOMY

This is an area with climatic as well as topographic limitations. In the fall of 1933 the first snow, which remained on the ground all winter, fell the middle of October; freezing temperatures occurred as late as June 10, 1934, and as early as the middle of August of the same year. This combination of temperature conditions caused a short potato crop and, coupled with drought, resulted in poor yields of hay. As the feeding season normally extends from the middle of October to the first of June, this was a major catastrophe, but one that occurs all too frequently, for most of the farms are located at the lower levels, where the frost hazard is greater.

Of the cleared land in production, 326 acres were in hay in 1934 and 165 acres in cultivated crops, the most important field crops being

FIG. 8—An abandoned house of typical Finnish log construction three miles southeast of Finland (A on Fig. 4). The former occupant moved to a more accessible location.

oats, 70 acres; potatoes, 65 acres; and barley, 10 acres. The hay cut is practically all wild grass, both on the uplands and on the marshes. None of the grains are threshed; all are fed in one form or another. The most promising crops are hay and potatoes: the latter crop under normal conditions yields 150 to 175 bushels of excellent quality to the acre. Berries do well, and some small fruits, principally strawberries, are raised; blackberries and blueberries grow wild.

The most important cash product of agriculture is cream. Farmers milk from one to six cows and sell cream, which is trucked to Two Harbors and Duluth, through the coöperative store. Weekly sales range from 30 gallons in the winter to 60 gallons in the summer; total sales for the year from 1750 to 2000 gallons. Other animal industries are of only slight importance. There are a few sheep and an even smaller number of goats, and most farmers keep a few hogs and some poultry to supply their own needs. Most of the farmers also have one horse or a team, though some hire their plowing done.

FARMSTEADS AND BUILDINGS

Some of the houses are of frame construction (Figs. 2, 3, and 9), but many are of logs (Figs. 3 and 8), squared on four sides, with the corners dovetailed and without projections. Barns and other outbuildings are also frequently of logs. Houses are without basements, storage being provided by root cellars (see Fig. 10). Although stone is abundant, it has not up to very recently been used in building

FIG. 9—The Matt Salo farmhouse, one and one-half miles southeast of Finland (H on Fig. 4). An average frame house and typical well. Note the ladder for fighting fires.

FIG. 10—The Isaac Koski farmstead two miles southeast of Finland on the Little Marais Road (F on Fig. 4). Note the large number of widely separated outbuildings, including the root cellar built into the hillside.

construction, not even for chimneys. There is a multiplicity of sheds and other outbuildings, including the ubiquitous Finnish bathhouse, all widely separated (see Fig. 10). In the peripheral portions of the Community, where Scandinavian elements of the population predominate, the characteristic buildings of the Finnish farmsteads disappear, to be replaced by frame buildings or log houses of more conventional construction.

Modern conveniences are few. There are no telephones except in the stores; there are few lighting systems; and labor-saving household devices are also lacking to a large extent. Water for domestic use is obtained from shallow dug wells, the stony soil precluding the possibility of driving pipe to the water-bearing layer ordinarily only a short distance below the surface on the lower land where most of the farms are located. On the upland farms, and even on others, these shallow wells go dry during prolonged droughts.

With meager returns from agriculture, supplementary sources of

FIG. 11—The Aimio Moisio farmstead, one and one-quarter miles south of Finland on the Beaver Bay–Cramer Road (G on Fig. 4). This is one of the best of the frame houses in the community.

income assume importance. The most important of these are work on the highways and fighting fires, seasonal employment at the lake-shore resorts, trapping and the raising of fur-bearing animals, and the woods, which supply game both in and out of season. Even with such additional sources of income some of the families are on relief.

Trade and Manufactures

Two stores divide the trade of the Finland Community. Both handle groceries and meat, and one, the coöperative store, a varied line of general merchandise as well. These stores both draw trade not only from Finland but from Isabella, to a lesser extent from Cramer, and to a limited degree from Little Marais as well. A lunchroom and a "beer parlor" complete the list of business establishments at Finland. The coöperative store, which profits from having the post office, did a total business of $30,000 for the fiscal year ending May 31, 1934, on a stock of merchandise that inventoried $1937.64 on the same date. Of this total trade 30 per cent represented cash sales to transients, county purchases, or trade originating in the CCC Camp. The rest came either from Finland or from the satellite communities. The total annual purchases by individuals or families range from a few dollars to more than $1200.00; the average is $250.00—a small amount for some of the rather large families.

The two stores profit from the tourist trade, since both have filling stations. Both the coöperative store and the state Forest Service maintain free campgrounds, and the noncoöperative store has cabins on the Baptism River for rent. Cabins are also available at Lax Lake, six miles to the south, where a small store and filling station supply limited needs (see Fig. 3).

There are no manufactures in Finland nor in the Community except that some lumber is sawed by two small rigs, one at Finland, the other near Lax Lake. Both are poorly located, and the volume of production is small.

Social Conditions

This is a community in which efforts have been pooled to a degree rather unusual in American life, at least in the past. There is a community hall, a coöperative store, and up to recently a community-owned threshing machine and small flour mill. These coöperative enterprises are, however, confined almost exclusively to the Finnish element of the population.

One of the handicaps of the Community is the lack of amusements. The CCC Camp, with its weekly motion pictures and parties, has remedied this lack during the past year; before that time an occasional party at the Finn Hall or Beaver Bay and an infrequent motion

picture at Two Harbors, thirty-nine miles distant, supplied the only recreation for the younger people. There is no church building, and there are no church services, so that the social features associated with these are also lacking.

The poverty of existence in the Finland Community is evident even in the only home of the dead, the cemetery on the Little Marais Road. Its unkempt condition suggests that life is much too hard to give much thought or time to the dead.

Tax Delinquency

Tax delinquency is a serious problem: every tax-delinquent acre narrows the tax base and adds to the burden of those who pay. Nearly 42 per cent of the total acreage is tax delinquent for five years or more and an additional 19 per cent for two to four years inclusive; on only 38 per cent of the total acreage are taxes fully paid to and including the 1932 assessment. Of the total levy of $3145.73 for 1932, 62 per cent was uncollected September 1, 1934 (Fig. 5). For Lake County, in which the Finland Community is located, tax delinquency for 1932 taxes was 28 per cent, as contrasted with the 62 per cent for the Finland Community. The growing area of tax-delinquent land, much of it not even worth the total of the unpaid taxes, threatens the economic stability of the Community. The most serious cases of tax delinquency occur in the unoccupied areas, mostly owned by nonresidents. For the landholdings larger than 1000 acres no taxes have been paid for five or more years on 80 per cent of the acreage; on only 22 per cent of the unoccupied land have taxes been fully paid to and including 1932. For the larger of such unoccupied landholdings it is generally true that the only portions for which taxes have been fully paid are those of highest assessed value where some timber, particularly white pine, makes it profitable to hold the land.

Of the occupied land, by contrast, 43 per cent is tax delinquent and only 14 per cent is delinquent for five years or more. The small percentage that the occupied land comprises of the total area, however, renders these percentages of but minor importance. To ensure any future for the Community it will be necessary to collect taxes from unoccupied as well as occupied land.

Summary and Conclusions

The Finland Community, located in an area of small and probably declining opportunity at present, maintains itself on an almost purely subsistence basis, with a minimum of dependence on other areas. This is a condition that must, even under the most favorable circumstances, persist in part, though alleviation of present conditions is possible as well as highly desirable.

There is little doubt that the present inhabitants are much better off on the average, even under the conditions that exist today, than they would be in one of the larger cities. In fact, it would be a serious mistake to move them to a "better" area. They have established themselves here of their own choice, and they would, properly enough, resent any attempt at displacement. Furthermore, the presence of inhabitants is desirable to provide for road maintenance, the prevention and fighting of fires, and the harvesting of the forest crop as it matures. It is much better that this should be done with local rather than imported labor. This does not, however, argue for any further influx of population, since the Community is not underpopulated at present.

Specifically, the following recommendations are made for the improvement of conditions in the Finland Community:

1. The State Forest should be expanded to include all the unoccupied, and particularly the tax-delinquent, land, which should be withdrawn permanently from agricultural use.

2. Forest industries, including the cutting and marketing of the mature forest crop on both state-owned and private land, should be initiated by the state with the use of local labor.

3. Attractive campgrounds and adequately furnished cabins should be provided for tourists. The numerous streams and lakes, the rocky landscape, the wild life, and the gorgeous coloring of the forest in the early fall make this an exceptionally attractive resort area.

4. Agriculture should be encouraged as a supplementary source of income, and outlets for small surpluses should be developed. These arrangements could easily be handled through the existing coöperative store; all that is necessary is the initiation of the program.

5. The attempt should be made to induce a few farmers, now living on inaccessible farms on secondary roads, to move to better locations; for this would not only benefit the farmers but would eliminate the necessity for maintaining unnecessary roads in passable condition.

Nothing has been suggested involving any considerable outlay of money; the enterprises would, when under way, repay the initial costs and provide as well a satisfactory income for the present population. A laissez-faire policy dooms the people of the Community to present low standards of living indefinitely and to a continuance on public relief and probably threatens the extinction of many of the present activities, possibly even of the Community.

THE FIRST CROSSING OF SOUTHWESTERN ARABIA

Hans Helfritz

IN 1933 I made a caravan journey of some 1200 miles from the Indian Ocean near Makalla to Hodeida in the Yemen on the Red Sea, thus accomplishing the first recorded crossing of the southwestern corner of Arabia by a European explorer.

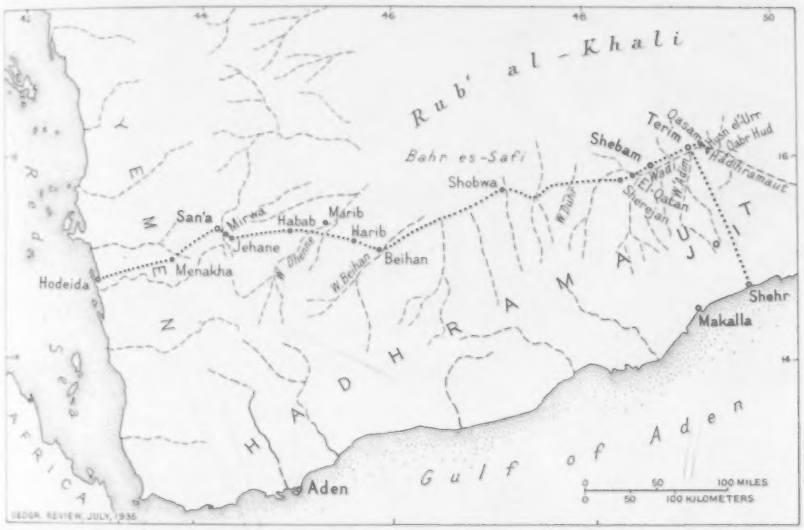


FIG. 1—Sketch map of southwestern Arabia showing the author's route. For the region from San'a to and including Wadi Hadhramaut this map is based on the following sources: (1) sketch map in "Rathjens-v.Wissmann Sudarabien-Reise," Vol. 3, Landeskundliche Ergebnisse, by Carl Rathjens and Hermann von Wissmann, Hamburg, 1934, p. 132 (see review elsewhere in this number of the *Review*); (2) map of Hadhramaut accompanying D. van der Meulen and H. von Wissmann, Hadramaut, Some of its Mysteries Unveiled, Leiden, 1932 (see *Geogr. Rev.*, Vol. 24, 1934, pp. 510–511); (3) for position of Habab, "Sammlung Eduard Glaser," Vol. 1, Eduard Glasers Reise nach Marib, edited by D. H. v. Muller and N. Rhodokanakis, *Kaiserl. Akad. der Wissenschaften*, Vienna, 1913, p. 109; (4) manuscript sketch map of part of author's route between Shebam and Beihan. The position of Mirwa corresponds to that of "W. el Marwa" near the town of Ghaiman as shown on Rathjens and Von Wissmann's map, 1 : 100,000, Sheet 3, accompanying "Landeskundliche Ergebnisse."

SHEHR TO THE WADI HADHRAMAUT

Led by Bedouins of the Saibani tribe, I began my journey early in February at Shehr, a small coast town some forty miles northeast of Makalla. On the third day out we entered the mountains and first followed a broad valley through whose center crawls the sandy Wadi 'Araf. To the left and right rose table-shaped uplands between two and three thousand feet in height. After half a day's journey the wadi came to an end, and we took a narrow caravan trail along steep, wild, and rugged slopes. This led us to the summit, which we reached on

the fourth day. The mountains here form a plateau at an altitude of some six to seven thousand feet. The vegetation of the Jol, as this plateau is called, is scanty; only dry thorn thickets and a few species of thick-leaved plants prosper. Abundant dew, precipitated during the cold nights, provides these plants with life-giving moisture. The upland surface falls gradually toward the interior and finally merges

FIG. 2—The ascent to the plateau from Shehr.

into the great desert. After four days' journey over the plateau we reached a system of numerous wadies, many of which are broad, with slopes that drop precipitously hundreds of feet from the plateau level.

WADI HADHRAMAUT

The largest valley of this region is the Wadi Hadhramaut, after which the surrounding territory is named. The wadi is about sixty miles long and in places as much as six miles wide. On many maps of Arabia the entire area as far as Oman is incorrectly marked "Hadhramaut." Strictly speaking, the district of Hadhramaut comprises the wadi of that name and its tributary valleys and the Wadi Do'an and extends no farther east than the fifty-first meridian east of Greenwich.

In Hadhramaut only the valleys are inhabited. There ground water, which alone makes irrigation possible, is found at no great depth. Durra, Indian corn, and various vegetables are cultivated. In places the entire wadi floor is covered with the large date plantations. Frankincense and myrrh are produced as of old.

Rain never falls in winter and only seldom in summer. Shortly after my arrival at Terim early in March, 1933, I witnessed a cloudburst, which started late in the afternoon with a heavy thunderstorm and lasted almost all night long. For decades such a deluge had not

occurred in the district, and it was considered a marvel by the inhabitants. The following morning the streets were changed into flowing streams, in which both young and old splashed merrily about. Seven houses in Terim had broken down overnight, and most of the others were damaged. The city wall was partly washed away, and many wells were completely choked with debris.

FIG. 3—The town of Qasam, Hadhramaut.

Hadhramaut, in contrast with the Yemen, is a land poor in animal life. Gazelles and ibexes live in the highlands. Ibex horns are fastened to the corners of the houses by the inhabitants, a custom undoubtedly of religious origin. A relief of the sacred ibex is frequently found on old Sabaean altars. There are various well known species of snakes and lizards in the region; for example, a lizard (*iwan*) of the *Uromastix* genus lives on the high plateau. Birds are rather scarce; the most widespread is the carrion-eating vulture.

The inhabitants of Hadhramaut show the typical physical characteristics of the southern Arabs. They are round-headed, short, and slim and have very dark skins. They show no signs of negro blood, however, since the palms of their hands and the soles of their feet are of an even blackness, whereas in the negro they are of a lighter color. Their eyes, also, with black irises are truly Arabian. The problem of these brachycephalic folk of southern Arabia is still unsolved.[1] Doubtless, however, as Sir Arthur Keith points out, there are certain racial connections between them and the peoples of Africa on the west and of India on the east.[2] During my journeys I gave particular attention

[1] Henry Field: The Ancient and Modern Inhabitants of Arabia, *Open Court*, Vol. 46, 1932, pp. 847–872.

[2] See Sir Arthur Keith and W. M. Krogman: The Racial Characters of the Southern Arabs, Appendix 1 in "Arabia Felix" by Bertram Thomas, New York, 1932.

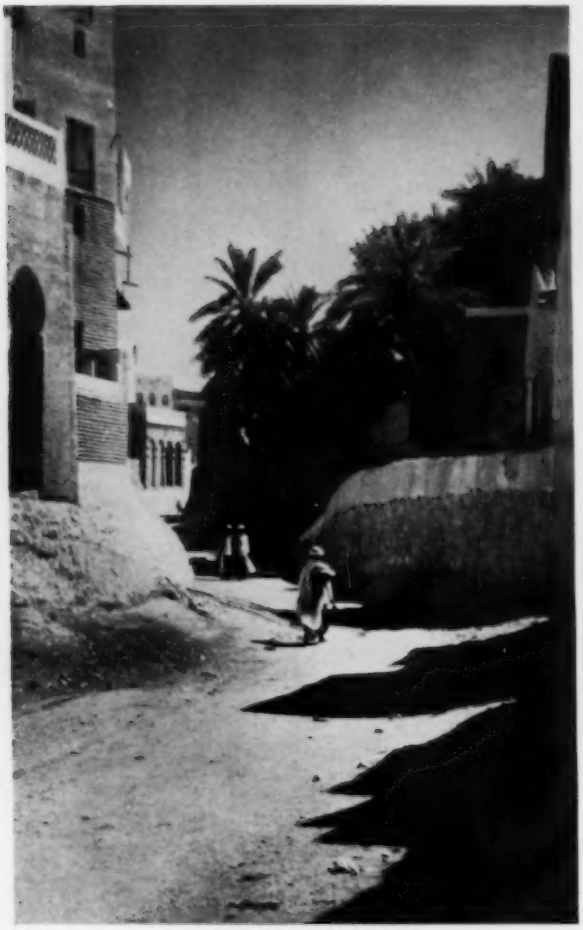


FIG. 4—Street scene in Terim.

to the music of the Bedouins and recorded it phonographically. Later my records were compared with records of Arabian music taken elsewhere. It was found that the music of the southern Arabs is almost identical with that of the Berbers of southern Morocco. Both show the same peculiarities of structure and intervals, and both differ markedly in these respects from other Arabian music. It must be remembered that the Bedouin songs are of great antiquity and have scarcely changed in the course of time. Relationship between southern Arabs and Berbers is also suggested by their architecture. The high buildings of northern Morocco are very similar to those of the cities of Hadhramaut.

From Terim I made a short expedition into the eastern part of the Wadi Hadhramaut, here called Wadi 'Adim. In a narrow part of the valley about sixteen miles from Terim lies the somewhat smaller city of Qasam. This city is completely surrounded by a wall and has a beautiful palace built largely in the style of the palaces of Terim.

Some eight miles from Qasam are the ruins of a Sabaean castle, called Husn el-'Urr. These ruins, which are in part well preserved, crown a rocky height that rises in the middle of the wadi and has an abrupt ascent on one side. Overlooking this steep slope stand the strongest and least damaged portions of the wall, erected from large, square, unbroken stones. All ruins date from the Sabaean age and

are built of blocks of stone in layers, never of clay.

The arrangement of the individual rooms at Husn el-'Urr is still easily recognizable in the foundations on the top of the hill. This arrangement, as well as the entire architecture, shows certain similarities to the ruins of Mycenae. At the foot of the hill I found the capital of a column with relief work on all four sides, in which the figures of an ibex and a lion could be recognized.

FIG. 5—Terrace cultivation, Haraz district, near Menakha, highlands of Yemen.

Beyond Husn el-'Urr the Wadi 'Adim leads to Qabr Hud, a place of pilgrimage of the southern Arabs, which, however, I did not visit.[3] The entire district east of Terim is inhabited by the Tamim Bedouins, a large tribe, subdivided into numerous smaller tribes. The faces and hands of the women and children in El-Furt, a village three miles west of Husn el-'Urr, were covered with peculiar dark-blue markings. The markings in the neighboring Qasam show an entirely different pattern. The men bear no markings whatever.

By Way of Shebam into the Rub' al-Khali

After returning to Terim I journeyed thence to Shebam, where I met some Bedouins from the tribe of the Beni Agil, who live near Harib

[3] See D. van der Meulen and H. von Wissmann: Hadramaut: Some of Its Mysteries Unveiled, Leiden, 1932, pp. 158–163.

FIG. 6

FIG. 7

FIG. 8

FIG. 6—Ibex relief on capital of a column in Husn el 'Urr.
FIG. 7—Detail of masonry, ruins of Sabaean castle at Husn el 'Urr.
FIG. 8—Tombs of the sheikhs of Harib.

in the Yemen. They had come to Shebam to market the products of their handicraft, namely carpets of goat's hair in black and white, firmly woven, with beautiful simple designs. In Hadhramaut the carpet industry is unknown. These traders were now returning to Harib, and after some negotiations one of them declared his readiness to serve me as guide. I settled everything with him and paid him in advance the price agreed on.

The next day, at the hour of departure, the Bedouin with whom I had made the contract failed to appear, but his brother Ambarak came in his stead. This was a ruse to enable them to avoid responsibility if necessary. According to the law of the Bedouins anyone is liable to the tribe for the life and safety of a stranger who has entrusted him-

self to his charge. This, however, holds exclusively for the person who has entered the contract. Ambarak therefore, was not responsible for me. If he had been taken to account in the Yemen and asked what right he had to bring a stranger into the land, he could have answered with a clear conscience: "What, stranger? My brother handed over to me this man Abdullah [I had chosen this Arabian name for myself]. Who he is and where he comes from, I don't know." Yet Ambarak proved an excellent guide and faithfully lived up to all the obligations assumed by his brother.

On the afternoon of March 3, 1933, we left Shebam and in the evening reached el-Qatan, the last sizable place of Hadhramaut. Near el-Qatan is the castle el-Hauta, the summer residence

FIG. 9

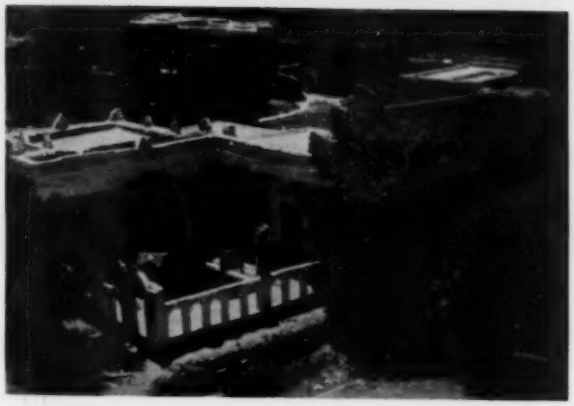


FIG. 10

FIG. 11

FIG. 9—Houses in Shebam.
FIG. 10—Inner court of a house.
FIG. 11—Menakha, the highlands of Yemen.

FIG. 12—Desert landscape near Harib.

of the Sultan of Shebam. I paid a visit to the Sultan, whom I had met before and who used all his eloquence to dissuade me from my plan, seeming to be convinced that I should have to pay for it with my life. At noon of the second day we came to the village of Sherejan, a few scattered Bedouin huts. At the well here we filled all our water bags, since we had to cross an entirely waterless stretch for the following six days.

Beyond Sherejan we followed the broad Wadi Duhr, which branches off from the Wadi Hadhramaut in a northwesterly direction, becomes broader, and gradually loses itself in the desert. Not far from Sherejan, the northern slope of the valley disappeared and the southern one was

FIG. 13—Village of Abu Teif near Harib.

FIG. 14—The town of Harib.

visible only as a dark strip in the distance. The desert, which we now entered, forms the southern part of the Rub' al-Khali, called "Bahr es-Safi" by the Arabs of this district. At first we still saw some sparse thornbushes growing in the Wadi Duhr. Then all vegetation ceased. The level surface of hard, dry clay is interrupted in places by stretches of loose sand. Wherever the ground was firm several parallel grooves or indentations could be distinguished. They were tracks made by the tread of innumerable camels that had passed here, since this route furnishes the only possible connection between Hadhramaut and the Yemen. Probably the old Himyaritic caravan route, leading from Hadhramaut by way of Beihan to Marib, also followed this course.

FIG. 15—Pass on the Hadhramaut-Yemen frontier, between Beihan and Harib.

FIG. 16—Fortified turrets of Harib.

This part of the Rub' al-Khali shows geographical characteristics similar to those described by Bertram Thomas for the eastern part of the desert. It is completely uninhabited owing to a total lack of water. Only robber bands are found, who are usually able to ride far on their excellent camels. We were troubled by them repeatedly; but since our caravan was well armed they did not dare to attack us.

After six days we again approached the mountains, which at this point protrude into the desert in a broad range. The wadies that lead down their sides are not sharply cut like those of Hadhramaut but have gently sloping banks. In their bottoms a little vegetation grows, and, since some water is always found there, the spurs of the mountains are inhabited. We approached the villages of Shobwa and 'Erma, which are about an hour's ride apart, both poor Bedouin settlements of small clay huts covered with straw. My companions told me that the inhabitants of this region are particularly hostile to strangers and that it is unsafe to enter these places in the company of a white man. Our caravan therefore made a wide detour around Shobwa. We stopped near 'Erma, where I had to hide in a thicket while some of the party filled our water bags at the village well.

WADI BEIHAN

It is a four days' journey from Shobwa to Beihan. Beyond Shobwa the mountains recede, and another stretch of the desert, the southernmost point of the Rub' al-Khali, had now to be traversed. The first day led us over even, firm clay ground. On the second day high dunes simulating mountains suddenly appeared in the distance. These dunes consist of loose, shifting sand, called "ramla" by the southern Arabs. On the third day we came upon strips of vegetation, spurge bush, in the broad trenches between the dunes. Ground water derived from the Wadi Beihan must extend far out into the desert. On the morning of the fourth day we reached the extreme end of the Wadi

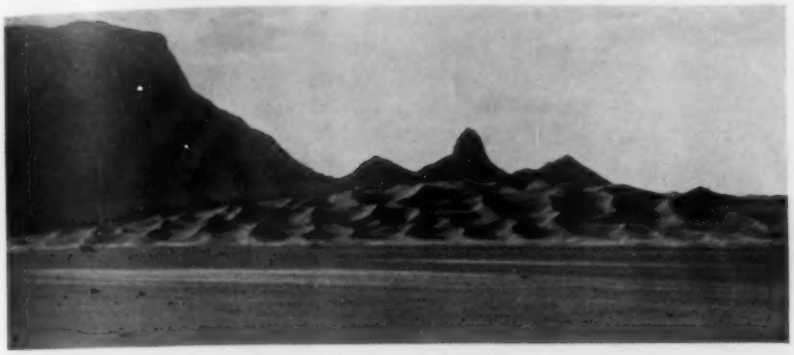


FIG. 17—The desert near Beihan.

Beihan, and as we followed it toward the mountains the vegetation steadily increased in richness. At evening on the fourth day we reached Beihan.

This settlement on the rim of the desert is considerably spread out. The low clay houses lie far apart, clustered in small groups around springs. Upon a near-by hill stands the house of the Sultan. The Beni Agil of my caravan were enemies of the Mass 'aben, who inhabit the Wadi Beihan. We therefore moved in a wide detour around the houses and only under cover of darkness approached an outlying well to quench our thirst and fill our water bags. As the Beni Agil wished to move on the same night, my guide and I separated from the caravan to stay another day in the Wadi Beihan. The next morning I paid a visit to the Sultan. His "palace," a crude and somewhat dilapidated tower-shaped building with only two rooms, made a poor impression. Yet he received me cordially and even gave me a guide instructed to show me the places where there are remains of Sabaean-Himyarite culture.

Fragments of a Himyarite king's castle, still partly visible, are found on the hill on which the Sultan's house stands. The inhabitants knew which stones bear inscriptions and uncovered these with their hands, though later sand sifted over them again. Some of the inscriptions are on the large rectangular stones of the old castle walls and others on individual obelisks. One of them bears a decree of a Katabanian king of pre-Christian time. The ground plan of the castle with its large gate and many rooms can still be distinguished. Systematic excavations in the Wadi Beihan, where there would be less difficulty than in the Yemen itself, should prove productive of rich returns. On the way from Beihan to Harib I saw a large number of little hills that showed traces of Sabaean-Himyarite buildings—proof that in ancient times the region must have been densely populated. Now there are no human settlements between Wadi Beihan and the frontier of the Yemen.

FIG. 18—In the Wadi Jehane.

HARIB AND THE YEMEN

On the evening of the second day after our departure from Beihan we reached the frontier of the Yemen at a pass about three thousand feet in elevation. At the summit two parallel walls extend for some six hundred feet along the route. On some of the large hewn stones of which the walls are built are Himyarite inscriptions. It was difficult to discover a purpose for this construction. It did not suggest a fortification. Perhaps the walls served for flood protection in ancient times of greater rainfall. They are seen in Figure 15.

Beyond the pass, in a broad basin partly surrounded by tall rock

FIG. 19—Landscape in the highlands of Yemen between Harib and San'a

walls, lies the city of Harib. On my arrival the governor immediately put me in jail, where I had to await the decision of the Imam of the Yemen, for the Harib region had only recently been subjected, after severe fighting. The city has about 2000 inhabitants and consists of rather miserable mud houses. There is no city wall, but everywhere fortified turrets tower high over the roofs. There are also many lone watchtowers in the neighborhood of the city.

The valley of Harib is inhabited principally by the Beni Garwi and the Beni 'Abd, who differ greatly from each other. The Beni Garwi have a rich black skin. They dress their dark, curly hair in a peculiar fashion not found elsewhere in Arabia: they shave their heads, except for a small tuft in the center of the scalp and two little knots, one in front of the forehead and one at the nape of the neck. The Beni 'Abd have lighter skin and straight hair and resemble Indians in appearance. The two tribes remain entirely separate and avoid intermarriage. In addition there is the smaller tribe of the Beni Agil, which corresponds more closely to the known southern Arabian type. The Beni Agil are the traders, continually on the road with their caravans, whereas the Beni Garwi and the Beni 'Abd never leave the boundaries of their territory.

After three weeks' stay at Harib an order arrived from the Imam of the Yemen to have me transported under escort to San 'a, by a route exactly prescribed. Because the direct way through Juba was closed by fighting against rebellious Bedouin tribes a route farther west was chosen, through a little known part of the Yemen.

During the first two days we passed through the high sand dunes of the marginal desert. In this region I met for the first time nomad Bedouins, who are rarely found in the Yemen. On the third day the ascent to the highlands of the Yemen began through the Wadi Dhenne. The Wadi Dhenne, here a dry, stony river bed, leads to one of the richly cultivated highland valleys of the Yemen. On the evening of the third day we reached Hababb, a settlement of single farms.

The way then led past Jehane to Mirwa, where there are notable ruins of the Sabaean period. My escorting soldiers, however, did not permit me to view these ruins. Mirwa lies a day's journey from San'a. On this ride from Harib to San'a, the inhabitants, some of whom had never seen a white man, proved very friendly toward me. From San'a, where I spent five days in jail, I was taken to the port of Hodeida.

ESKIMO MIGRATIONS IN GREENLAND

Therkel Mathiassen

FIG. 1—Map of Greenland showing the chief localities mentioned in the text.

Some years ago I wrote for the *Geographical Review* a paper entitled "An Old Eskimo Culture in West Greenland." It described the results of an expedition to the Upernivik District in the summer of 1929.[1] This expedition was the beginning of a systematic investigation of Greenland's Eskimo remains, under the support of the Danish government. In 1930 I excavated in the Kangâmiut area on the southern West Coast,[2] in 1931–1932 in Angmagssalik on the southern East Coast,[3] in the late summer months of 1932 on the southernmost part of the East Coast (as a member of Dr. Knud Rasmussen's Seventh Thule Expedition), in 1933 in Disko Bay on the northern West Coast,[4] and in 1934 in Julianehaab District on the southernmost West Coast. At the same time other Danish expeditions were excavating on the northern East Coast—Ejnar Mikkelsen's expedition at Kangerdlugssuaq[5] and the Three-Year Expedition, led by Lauge Koch, at Clavering Island and in the Ella Island region.[6] These investigations have made known some of the main features of the cultural development and migrations of the Greenland Eskimos, and, as last year's expedition probably was my own last trip to Greenland, the time is opportune for a review of the results obtained.

[1] Therkel Mathiassen: An Old Eskimo Culture in West Greenland, *Geogr. Rev.*, Vol. 20, 1930, pp. 605–614. The final report on this expedition, by the same author, was published under the title "Inugsuk, a Mediaeval Eskimo Settlement in Upernivik District, West Greenland," *Meddelelser om Grønland*, Vol. 77, 1931, pp. 145–340.

[2] Therkel Mathiassen: Ancient Eskimo Settlements in the Kangâmiut Area, *Meddelelser om Grønland*, Vol. 91, No. 1, 1931.

[3] *Idem:* Prehistory of the Angmagssalik Eskimos, *ibid.*, Vol. 92, No. 4, 1933.

[4] *Idem:* Contributions to the Archaeology of Disko Bay, *ibid.*, Vol. 93, No. 2, 1934.

[5] *Idem:* Eskimo Finds from the Kangerdlugssuaq Region, *ibid.*, Vol. 104, No. 9, 1934.

[6] Helge Larsen: Dødemandsbugten, an Eskimo Settlement on Clavering Island, *ibid.*, Vol. 102, No. 1, 1934.

The Cape York District

I shall begin with Greenland's gateway from Arctic America—the Cape York District, the country of the Polar Eskimos. This district is now the most poorly investigated part of Greenland archeologically. We have, however, one important find from this country, the so-called "Comer's Midden" find, excavated in 1916 by the American whaler, George Comer, and the members of the Danish Second Thule Expedition, Knud Rasmussen, Peter Freuchen, and Lauge Koch.[7]

The find from Comer's Midden—comprising about 600 specimens—is the only substantial find of pure Thule culture in Greenland. Here are the thin harpoon head with open socket, the lamp with wick ledge, and a large number of baleen implements. The find is closely related to the large finds from the central area of the Thule culture—Naujan, Ponds Inlet, Malerualik, etc.;[8] but it is later than these. Comer's find no doubt represents the first Eskimo immigrants in Greenland, the Eskimos of the Thule culture, who came from the Canadian Arctic.

The Polar Eskimos are probably descendants of these Thule Eskimos. Certain features in their culture point in this direction: their round stone house; their dress, which is the same as that ascribed to the Tunit, the Central Eskimo name of the Thule people; the thin harpoon head with closed socket and the winged needlecase, two of the most important types of the Thule culture—these were used by the Polar Eskimos till quite recent times. During their centuries-long isolation the culture of this tribe has of course changed a good deal: some of their implements—the woman's boat, the kayak, the bow, the salmon spear—were lost, but some of them were reintroduced by an immigration from Baffin Island in the 1860's.

Northern West Greenland: The Oldest Culture

The oldest finds from West Greenland were discovered in the excavation of five old houses on the small island of Igdlutalik in Disko Bay in 1933. The houses were small, round, dug down into the ground, some of them two together with a common entrance passage. The walls were loosely built of scattered stones; there was a paved floor; in some there was a "kitchen" for cooking with bone and blubber in a bulge in the front wall. The houses resemble very closely the "whalebone house" of the Canadian Thule culture.

The specimens are closely related to the Thule culture—thin harpoon heads, arrows with conical tang with two knobs, two-handed

[7] Clark Wissler: Archaeology of the Polar Eskimo, *Anthropol. Papers Amer. Museum of Nat. Hist.*, Vol. 22, 1917–1924, pp. 103–166; Therkel Mathiassen: Archæology of the Central Eskimos (Rept. of the Fifth Thule Expedition 1921–24, Vol. 4), 2 vols., Copenhagen, 1927, reference in Vol. 1, pp. 293–304.

[8] See Mathiassen, Archæology of the Central Eskimos, and a preliminary report by the same author in the *Geogr. Rev.*, Vol. 15, 1925, pp. 544–549.

scrapers, lamp with row of knobs and with ledge, snow goggles, comb in human shape, dolls. The only important difference from the Thule culture is that the harpoon heads mostly have closed sockets.

This find reveals that West Greenland received its first population from the north, from the Cape York District. The Igdlutalik find is

FIG. 2—The village site of Igdlutalik, Disko Bay.

a little later than Comer's Midden: a local West Greenland development has just begun.

INUGSUK

The next stage in the culture development is represented by the Inugsuk find[9] in Upernivik District. This large find—more than 5000 specimens—is still one of the cornerstones of Greenlandic Eskimo chronology. The finds from the old midden at Inugsuk are mostly thin harpoon heads with closed socket (the "Inugsuk type"), fusiform harpoon foreshafts, sealing scratchers, arrowheads with knobs on the tang, gull hooks, bola balls, broad sledge shoes, broad snow knives with one shoulder, knives with end and side blades, two-handed scrapers, women's knives without a tang, lamps with wick ledge, winged needlecases, many ornamental bodkins, dolls and toys, and a large number of baleen implements—bows, snow-beaters, drums, platform mats, bowls, etc. The culture shows close relation to the Thule culture, but a local West Greenland development has begun, and something new has been added—an influence from the medieval Norse culture in South Greenland. The midden contained not only

[9] See Mathiassen, An Old Eskimo Culture in West Greenland.

specimens actually received from the Norsemen—a lump of church-bell metal, a piece of woven cloth, a draughts piece—but also wooden carvings—a doll and a head—that indicate that the Inugsuk Eskimos must have seen Norsemen. Coopered vessels and antler spoons of a certain type also show Norse influence. These Norse finds enable us to date the whole Inugsuk find to the thirteenth and fourteenth centuries. Possibly some of the specimens can be traced back to the visit

FIG. 3

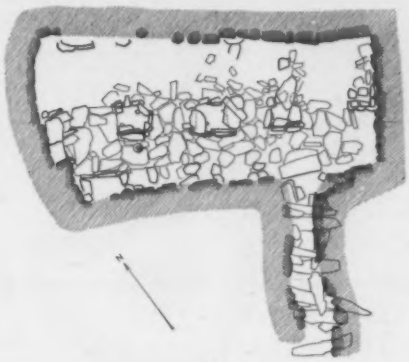


FIG. 4

FIG. 3—Plan of house ruin of oldest type. Igdlorssuit, Disko Bay.
FIG. 4—Plan of house ruin of eighteenth century type. Igdlutalik, Disko Bay.

of the three Norsemen who in the latter part of the thirteenth century erected the cairn with rune-inscribed stone found on Kingigtorssuaq, an island close to Inugsuk.

With this dating of the Inugsuk find, the Igdlutalik find, which shows no connection with the Norsemen, must be assigned to the eleventh or tenth century, Comer's midden to a little earlier time.

THE CULTURE OF THE FIFTEENTH AND SIXTEENTH CENTURIES

On Igdlutalik in Disko Bay two small, square, double houses fronted by a large midden yielded a find of about two thousand specimens. Objects from the lower part of the midden proved to be nearly identical with those of Inugsuk, the only difference being that the harpoon heads mostly belonged to the later flat types. Among the more interesting specimens was a sealing net of baleen. This midden also contained several Norse specimens—a dagger handle, a dragon carving, a loom weight. Both these and the Eskimo stage of culture point to the fifteenth century.

The houses and the upper layers of the midden show a still more advanced culture stage: the old lamps with wick ledge are being replaced by new types; there are arrowheads and bird-dart heads with screw on the tang, heavy bladder dart heads with rows of barbs,

women's knives with an intermediate piece between handle and blade, wound plugs of wood. An ice scoop of baleen and a shark's-tooth knife should also be noted. A Norse doll shows the dress of a style later than the Inugsuk doll. No glass beads or other things from the whalers have yet appeared. This find is probably from the sixteenth century.

Culture of the Seventeenth and Eighteenth Centuries

A large, well built house at Igdlutalik dates from the beginning of the eighteenth century, i.e. before the Danish colonization of Disko Bay, which began in 1734. This square house, accommodating a large number of families, is now the most used type of dwelling in northern West Greenland.

The culture of this period is characterized by a great number of new local West Greenland types: the harpoon heads exhibit many different forms, all flat; the kayak implements are growing more perfect; many glass beads and European tools appear, brought to the country by whalers.

The culture of the period after the colonization, known from the late finds from Inugsuk and some finds from the large settlements of Igdlorssuit in Disko Bay, excavated in 1933, shows still further development. Faïence and earthenware shards are very numerous in these finds. We are now close to the period whose West Greenland culture is well known through literature and ethnographical-museum specimens.

The West Greenland "Stone Age"

In 1907 Professor O. Solberg[10] described a number of stone implements from northern West Greenland, mainly from some settlements on Disko Bay—Sermermiut, Qeqertaq, and Nugag. This material, which he had found in European museums, chiefly in Stockholm, Oslo, and Copenhagen, had been for the most part collected by Greenlanders. The implements—weapon and knife blades, adzes, drills, scrapers of different kinds, and the like—were mainly of siliceous slate, chalcedony, jasper, rock crystal, etc., from the basalt around Disko Bay. Solberg suggested that these stone implements belonged to a very remote period, a West Greenland Stone Age, much earlier than the Norse colonization of Greenland, which began shortly before 1000 A.D.

How does this Stone Age fit in with the culture development described above? Some of the implements are types widely distributed with the Thule culture and thus are very old; others are local types not appearing outside West Greenland. Nearly all are represented

[10] Beiträge zur Vorgeschichte der Osteskimo, *Videnskabs-Selskabets Skrifter: II, Hist.-filosofisk Klasse*, Christiania, 1907.

in the large finds—Inugsuk, Igdlutalik, and Igdlorssuit. Most of them belong to the Inugsuk culture, but many of them were in use at a much later time, in fact until abundance of iron made them superfluous. As a matter of fact, West Greenland has never had a real "Stone Age"; even the oldest finds contain some iron, telluric iron from the basalt; in the Cape York District the Eskimos were well

FIG. 5—The village site of Utorqait, Kangâmiut area. The houses are situated to the left of the tents.

acquainted with meteoric iron, which they regarded as a rock and hammered cold, just as the Canadian Eskimos did with the native copper.

The implements on which Solberg based his Stone Age were mostly collected at beaches below big middens in course of destruction by wave action; the bone, wooden, and baleen implements decayed or were washed away, but the stone implements survived and were collected.

Solberg is right, however, in assuming a rather high age for the Eskimo habitation on the northern West Coast. About a thousand years has probably passed since this country received its first Eskimo inhabitants through an immigration from the north.

THE SOUTHERN WEST COAST: THE KANGÂMIUT AREA

In 1930 we investigated the northern part of Sukkertoppen District. The region around the outpost of Kangâmiut is very rich in old Eskimo habitations. On a stretch of coast 40 kilometers long from north to south 40 old Eskimo sites were located, many of them

fairly large villages. Excavations were made at two of the largest, Utorqait and Qeqertarmiut, and at three smaller ones.

Utorqait, "the village of the old people," had 24 house ruins, thickly overgrown with grass and willow. Most of them belonged to the old, round type, which we know as the oldest in Disko Bay. There were also a few of the large square type.

FIG. 6—The village site of Qeqertarmiut, Kangâmiut area.

Qeqertarmiut is on an island thickly covered with a large refuse heap. Conditions for preserving specimens are much poorer here than farther north, where the deeper layers never thaw, even in summer. Only in the bottom layers at Qeqertarmiut had some wooden and baleen implements survived decay; at Utorqait even the bone implements had often moldered away.

The oldest houses at Utorqait and the bottom layers of Qeqertarmiut exhibited a culture closely related to the Inugsuk find, but a little younger. The predominating harpoon head was the Inugiak type; the arrowheads had tang with knobs; there were several evidences of dog driving, now no longer practiced so far south; the lamps had wick ledges; there were coopered vessels and spoons of "Norse type," church-bell metal, and a toy Norse ship telling of connection with the Norsemen. Among the specimens may be mentioned a curious bone penis, possibly used at the ritual feasts. The age of this oldest culture in the Kangâmiut area has been put at 1350–1500. It apparently represents a migration from the north, the migration which destroyed the northernmost Norse settlements, the Vestribygd in Godthaab.

In the sixteenth century[11] the culture changes in the same way as at Disko Bay: the same new implements appear, the harpoon heads are flat, and the wick ledge appears on the lamps. But the old round houses were still used down to the middle of the seventeenth century; in a few of them were found glass beads from the first whalers, who made their appearance on this coast during the first part of the

FIG. 7—The village site of Tugtutûp Isua, Julianehaab District.

seventeenth century. In the middle of the seventeenth century the large communal houses appear and the culture goes through the same development as on the northern West Coast.

JULIANEHAAB DISTRICT

The Julianehaab District, now the most densely populated part of Greenland, also suggested a numerous population in ancient times; more than 200 ruined settlements are known.

In the summer of 1934 we excavated the three largest ruined villages in the district: Tugtutûp Isua, with 24 house ruins; Igdlutalik, with 25; and Ũnartoq, with 26. Most of these ruins belonged to the old round type known from the northern parts of the West Coast. The conditions for preserving specimens are, however, very poor here in South Greenland, with the alternate freezing and thawing of the ground. Many houses were entirely devoid of bones and specimens of bone, wood, and baleen. The finds in these oldest houses are characterized by lamps with wick ledges and by Norse relics—loom

[11] Known from some houses at Utorqait and a small find from Igdlutalik near Kangâmiut, now in the Museum of the American Indian, Heye Foundation, New York.

weights (one with a rune inscription), church-bell metal, whetstones, net sinkers, cloth, iron objects. The latest of the houses contained a glass bead from the whalers. These houses seem to belong to the period from the middle of the fourteenth to the middle of the seventeenth century.

This is the period of the decline and final disappearance of the

FIG. 8—The village site of Ũnartoq, Julianehaab district, the largest known ruined village in West Greenland (26 ruins).

Norse settlements. We first hear about the Eskimos in this part of Greenland in 1379, when they attacked and destroyed some Norse farms. Conditions rapidly became worse for the Norsemen. The picture that Dr. Nörlund's excavations at the old Herjolfsnes give us of conditions here during the fourteenth and fifteenth centuries[12] is distressing—the population degenerate, weak, undernourished, disease stricken. With the well known contemptuous attitude of the Norsemen toward foreigners, their relations with the Eskimo invaders had probably not been friendly. And when these numerous people began to attack the Norse settlements, the Norsemen had not force enough to resist. The Eskimos took anything they could use from the abandoned farms and settlements. The many Norse things found in the old Eskimo houses are probably the result of this plundering. Toward the year 1500 the Norsemen were entirely extinguished: the Eskimos occupied the whole territory.

The earliest Eskimo settlements in South Greenland are nearly all halfway up the fiords. Coming from the north, the Eskimos were still

[12] See the review by William Hovgaard: The Norsemen in Greenland: Recent Discoveries at Herjolfsnes, *Geogr. Rev.*, Vol. 15, 1925, pp. 605–616.

in some degree dependent on ice hunting in the winter; their kayak culture was not developed enough to allow kayak hunting in the open sea during the stormy winter months. And the heads of the fiords were occupied by the Norsemen.

After the disappearance of the Norsemen the Eskimo habitations became more widespread. In place of the few large villages numbers of smaller settlements were scattered over the entire territory, on the outer skerries and up the fiords; people were able to go kayak hunting in winter, for the modern kayak outfit had been invented.

The culture of the seventeenth and eighteenth centuries closely resembles the culture of the same period farther north, save that, in these less accessible territories, it has a more old-fashioned stamp; types such as thin harpoon heads and lamps with wick ledges apparently have been in use longer here than in any other part of West Greenland. Danish colonization was also late here: the colony of Julianehaab was founded in 1773.

In Julianehaab District the oldest Eskimo settlements found thus seem to derive from the fourteenth century. But how then account for the Eskimo remains that, according to Are Frode's account, the first Norse immigrants saw when they arrived? If his narrative is correct—it was written about 150 years after the events took place—these remains must have been left by a small group of Eskimos from the northern West Coast, a sporadic settlement quickly abandoned on account of the unfavorable winter climate. That the entire remains of an earlier Eskimo settlement would have vanished below the sea through the sinking of the land still in progress I do not believe. The oldest Eskimo ruins in the district are usually situated higher than the seventeenth and eighteenth-century ruins, which very often are being washed away by the submergence of the land. The Greenlandic coast seems to have been oscillating during the past centuries.

Southern East Greenland

The Angmagssalik territory is rich in old Eskimo remains. Nearly 100 old Eskimo sites were located and 8 old villages excavated during the year 1931–1932, which I spent there.

Apparently the immigration that in the latter part of the fourteenth century brought the first Eskimos to the Julianehaab District continued round Cape Farewell and up the East Coast, while the Norsemen still occupied the fiords of the southern West Coast. If the story of Bjorn Jorsalfar is accepted, "Gunbjorn's Skar," which is probably somewhere near Angmagssalik, was inhabited in 1385–1387. At any rate, the oldest houses in Angmagssalik—in the old villages of Pôrtusoq, Kangartik, Savanganeq, and Sukersit—are of the old round type well known from the West Coast, and the culture is Inugsuk, as we

know it from the oldest houses in the Kangâmiut and Julianehaab territories. At several places on the coast between Angmagssalik and Cape Farewell houses of the same type were also found and excavated but yielded very little material on account of the decay of the bones.

In the latter part of the seventeenth or the beginning of the

FIG. 9—Ruin of one of the large communal houses, Angmagssalik.

eighteenth century a new immigration seems to have come to Angmagssalik from the West Coast. It brought the large square communal houses and a number of newer West Greenland types, also a little iron, some glass beads, and a little Norse church-bell metal, often shaped into eardrops.

During the eighteenth and nineteenth centuries the Angmagssalik Eskimos developed their own peculiar culture and their beautiful decoration with bone figures in relief attached to wooden water pails, chests, and eyeshades—the culture that Holm found flourishing when he came to Angmagssalik in 1884 and that he and Thalbitzer have fully described.[13]

At one place on the coast, however, a small group of the first immigrants were living their own isolated life, uninfluenced by the outer world, for a couple of centuries. This was at the large Kangerdlugssuaq fiord between Angmagssalik and Scoresby Sound. From here Amdrup and later Ejnar Mikkelsen's expeditions brought a good deal of material, showing a nearly pure Inugsuk culture with a certain local stamp. The second immigration to Angmagssalik

[13] William Thalbitzer, edit.: The Ammassalik Eskimo, Part 1, *Meddelelser om Grønland*, Vol. 39, 1914.

did not reach so far north, and this small, isolated population gradually died out.

Northern East Greenland

Northern East Greenland has no living population except the recently founded colony at Scoresby Sound. That is the reason why its remains attracted the interest of explorers long before the Eskimo ruins in other parts of Greenland. A great number of specimens from Northeast Greenland have been collected and described, but the lack of large, properly excavated finds has restricted their value. The recently described large find from Dódemandsbugten, excavated by Helge Larsen, gives us the first adequate idea of the culture development in this area. Dódemandsbugten is on the south coast of Clavering Island and is far the largest village site in East Greenland. It has 43 house ruins, of which 23 were excavated, yielding 2400 specimens.

The oldest houses were of the same type as the oldest houses at Angmagssalik—small and round and containing a pure Inugsuk culture. It must represent a continuation of the first immigration to Angmagssalik, which brought the first Eskimos to Northeast Greenland, probably during the sixteenth century.

The later houses, however, are of another type—square, narrow, with two protrusions from the front, reminiscent in some respects of the houses of the Polar Eskimos. At the same time they contain some types—Thule harpoon heads, snow knives, bird-dart side prongs with outside barbs, etc.—unknown on both the southern East Coast and the southern West Coast, which thus must have come with a migration from the Cape York District around North Greenland, probably sometime in the seventeenth or in the latter part of the sixteenth century.

The later stage of these "mixed cultures" has still smaller, narrower square houses and many local Northeast Greenland types: the culture has a pronounced local stamp.

In 1823 Clavering met Eskimos at Clavering Island; nobody has seen them since. They must have become extinct during the nineteenth century, probably in the same way as other isolated Eskimo tribes (Southampton Island, Kangerdlugssuaq) did—by degeneration, intermarriage, and finally extinction by disease or famine.

The Question of Eskimo Origins

This brings to an end the review of the cultural development of the Greenlandic Eskimos. Culturally Greenland is a cul-de-sac; its development has not influenced the rest of the Eskimo domain. In the Central Eskimo territory development since the time of the Thule

culture has been affected by the migration to the seacoast of the recent Central Eskimo culture, which in many respects has the stamp of an inland culture, and which, in its purest form, is found among the Caribou Eskimos of the Barren Grounds. Birket-Smith[14] regards these Caribou Eskimos as the last survivors of the "Primordial Eskimos," whose primitive culture was developed on the Barren Grounds before it had got so far as to take on a sea facies. According to this view the Thule culture would be explained as a "Neo-Eskimo" wave, coming from Alaska and obliterating the old culture in the central region and going on to Greenland, which probably had never been touched by the oldest "Palæ-Eskimo" culture. Still later a new wave from the interior extinguished the Thule culture in the central region. Against this theory I have raised several objections.[15]

1. We have no archeological evidence of any older coast culture in the central region than the Thule culture.

2. I cannot admit that the types of the Thule culture are in any respect at a more developed stage than the corresponding types of the culture of the Caribou Eskimos.

3. The culture of the Caribou Eskimos contains only elements that may be derived either from the Thule culture or from more recent Indian influence.

I am inclined to regard the culture of the Caribou Eskimos as residual rather than primitive. And I think it more natural to look to the west, to Alaska and—probably—Asia, as the original home of the Eskimos. Then the Thule migration from west to east across Arctic America would represent the first Eskimo peopling of Arctic Canada and Greenland.

Several new excavations have since been made, but nothing as yet affords a final solution of this problem. In Alaska the interesting Van Valin collection from Point Barrow has been recently described.[16] It reveals an old culture closely related to the Thule culture. Farther west, at Cape Prince of Wales and St. Lawrence Island, large excavations have been made by Jenness,[17] Collins,[18] and Geist; but only short reports have been published. The main conclusion is that a very ancient culture, the "Bering Sea Culture," seems, at these places anyway, to be older than the Thule culture. At St. Lawrence Island the "Bering Sea Culture," characterized by a rich, curvilinear ornamentation, is found in the bottom layers; above this is the "Punuk

[14] Kaj Birket-Smith: The Caribou Eskimos (Rept. of the Fifth Thule Expedition 1921–24, Vol. 5), 2 vols., Copenhagen, 1929.

[15] See discussion in *Amer. Anthropologist*, Vol. 32 (N.S.), 1930, pp. 591–624.

[16] J. A. Mason: Excavations of Eskimo Thule Culture Sites at Point Barrow, Alaska, *Proc. 23rd Internatl. Congr. of Americanists, Held at New York, Sept. 17–22, 1928*, New York, 1930, pp. 383–394.

[17] D. Jenness: Archæological Investigations in Bering Strait, 1926, *Natl. Museum of Canada Bull. No. 50 (Ann. Rept. for 1926)*, 1928, pp. 71–80.

[18] H. B. Collins, Jr.: Prehistoric Art of the Alaskan Eskimo, *Smithsonian Misc. Colls.*, Vol. 81, No. 14, Washington, 1929; *idem:* Prehistoric Eskimo Culture on St. Lawrence Island, *Geogr. Rev.*, Vol. 22, 1932, pp. 107–119.

Stage," with rich ornamentation of another style; and above this, close to historical time, is the Thule culture, which here seems to be quite recent. Apparently Thule Eskimos invaded the Bering Strait region in quite recent time, but from where? From northern Alaska? Or from Asia? We must remember, however, that the discussion as yet has dealt only with the decoration and the harpoon heads; until the newly excavated material has been completely described it is difficult to evaluate its significance. The great antiquity of the Thule culture in Alaska has received strong support from Dr. Frederica de Laguna's find of Thule harpoon heads in the bottom layers at Cook Inlet, southern Alaska.[19]

The discovery of the old Bering Sea culture seems to put the Eskimo settlement of Alaska much further back than previously assumed; and I think it will be difficult to agree with Birket-Smith's theory of the first peopling of Alaska from the east by the "Palæ-Eskimos." The ornamentation of this Bering Sea culture seems to have closer connection with Asia—with the Amur country and the Ainu culture, as Jenness[20] has pointed out. But we are still far from having solved these questions. An attempt to trace the Eskimo culture to the European Paleolithic[21] has not given an affirmative answer.

Another unsolved question is that of the Cape Dorset culture[22] in Labrador and on the eastern shores of Hudson Bay. Discovery by Eskimos and other untrained excavators may explain why the finds are intermingled with implements from the Thule culture. For that reason I regarded the Cape Dorset culture simply as a deviation of the Thule culture with a strong local stamp.[23] Since then, however, W. J. Wintemberg has discovered sites with a pure Cape Dorset culture along the northwestern coast of Newfoundland.[24] It is a very peculiar culture—no dog sledges, no whale hunting, no drills, no throwing sticks, no kayaks, no umiaks. On the other hand, there are doubly convex scrapers, soapstone plummets, semilunar knives, cylindrical hammerstones. This culture certainly cannot be derived from the Thule culture, and where the two cultures meet, the Dorset seems to be the older. Jenness set forth a new hypothesis—that this Dorset culture derived from the Caribou Eskimos, whose first immigration would then not have gone to the west, to Alaska, but to the east, to Labrador and Newfoundland, where it later influenced the

[19] Frederica de Laguna: The Archaeology of Cook Inlet, Alaska, The University [of Pennsylvania] Museum, Philadelphia, 1934.

[20] Diamond Jenness: The Problem of the Eskimo, in "The American Aborigines: Their Origin and Antiquity," edited by Diamond Jenness, published for presentation at the Fifth Pacific Science Congress, Canada, 1933, Toronto, 1933, pp. 371–396, reference on p. 387.

[21] Frederica de Laguna: A Comparison of Eskimo and Palaeolithic Art, *Amer. Journ. of Archaeology*, Vol. 36, 1932, pp. 477–511, and Vol. 37, 1933, pp. 77–107.

[22] Diamond Jenness: A New Eskimo Culture in Hudson Bay, *Geogr. Rev.*, Vol. 15, 1925, pp. 428–437.

[23] Mathiassen, Archæology of the Central Eskimos, Vol. 2, pp. 164–165.

[24] Jenness, The Problem of the Eskimo, p. 390.

Thule wave. The only support for this hypothesis is, however, that the Dorset culture seems to be more inland in character than the Thule culture. There does not seem to be any other similarity between the Dorset culture and the Caribou Eskimo culture, as we know it today. But are these people who have left their traces on the coasts of Newfoundland Eskimos at all? The culture seems to have strong Indian connection.

The final result of these reflections is that as yet we know too little to solve the question of origin of the Eskimos. Certain main features of their culture development are known; but much more research and analysis are necessary if the main question regarding this small but interesting people is to be answered.

EARTHQUAKES AS A CAUSE OF GLACIER AVALANCHES IN THE CAUCASUS

Werner Heybrock

IN the Alps the coming of spring and summer is invariably heralded by frequent snow avalanches. As noted by Allix[1] in his study of snow avalanches and their causes, the cliffs of Alpine glaciers are also prone to give way in the summertime and produce icefalls. The comparative rarity of these glacier avalanches and their occurrence at higher altitudes make them, however, a less constant source of danger.

Avalanches in the Alps

The best-known glacier avalanches in the Alps during the last century were those of the Bies and Giétroz glaciers. Both terminate near or at the edge of steep cliffs, which were without doubt the indirect cause of the avalanches. The immediate cause must have been either advance of the glaciers or weakening of the adhesion to the mountainside, both explainable by meteorological changes. The avalanche of the Altels Glacier in the Bernese Oberland of September 11, 1895, a repetition of the disaster of the same glacier in 1782, is also well known. Part of that hanging glacier, which terminates at about 3000 meters, broke off at 3300 meters and rushed down the Spitalmatte toward Gemmi Pass, causing wide destruction. Extensive forest areas were swept down by the strong wind accompanying it. According to Heim,[2] the Altels Glacier is usually frozen to its steeply inclined (30 degrees) rocky bed, but during the warm summer of 1895 the adhesion lessened and a considerable part of the glacier broke off.

Glacier Avalanches in the Caucasus

Similar, but much greater, glacier avalanches have been reported from the thinly inhabited Central Caucasus. Comparison with those in the Alps is, however, unsatisfactory. For, whereas the snouts of the Alpine glaciers terminate at rocky cliffs or on steep slopes, those of the Caucasian glaciers lie in gently sloping valleys. The critical areas for avalanching, instead of being at the lower ends, are near the heads. There are, remarkably enough, three such glaciers on the northern slope of the Kazbek massif, the Devdorak, Dzariu, and Genal-don, which have been prone to avalanches in the past.

The most recent avalanches of Devdorak Glacier occurred in 1832,

[1] André Allix: Avalanches, *Geogr. Rev.*, Vol. 14, 1924, pp. 519–560.

[2] Albert Heim: Die Gletscherlawine an der Altels am 11. September 1895, *Neujahrsblatt Naturforschenden Gesell. in Zürich auf das Jahr 1896 (No. 98)*, 1895.

1842, and 1855.[3] Large masses of ice rushed down the Amilishka Valley and the Kaba-khi Valley and did not stop until they had reached the main valley of the Terek River, a distance of about seven kilometers from the point of origin. More than once the Terek has been dammed and the Georgian highway,[4] which follows the valley, obstructed. The volume of ice and rubble in the avalanche of 1832 has been estimated by Vardanyants[5] to have been about 15 million cubic meters, a much greater amount than is usual for glacier avalanches in the Alps.

There is no accurate information concerning the catastrophe of the Dzariu Glacier. According to the inhabitants of the sparsely settled region, it occurred sometime between 1840 and 1850. The most recent avalanche, that of the Genal-don, took place in 1902.

Causes of the Avalanching

These catastrophic avalanches, particularly those of the Devdorak Glacier, attracted the attention of many scientists during the second half of the last century. The explanations, however, seemed inadequate. After the Genal-don avalanche of 1902, in which a number of people were killed, there was a revival of interest in this problem. Again the scientists failed to reach satisfactory conclusions, and the phenomenon remained unexplained.

Almost all the investigators of the Devdorak Glacier have ascribed its avalanches to water accumulated in the upper reaches and loosed by the bursting of an ice dam. Statkovski,[6] for example, suggested in his revised theory that as the glacier advanced into the narrow gorge of the Amilishka River free passage of the ice was hindered. As advance continued, the ice became so thick in the gorge that a temporary dam was formed. The water held behind this barrier eventually burst out, carrying with it a large amount of ice and rubble.

This supposition, however, seems quite impossible. The free passage of ice in the narrow gorge of the Amilishka River could never be hindered in this manner; for the narrower the gorge, the smaller the glacier's body and the more rapid its movement. Compare this, for example, with the movement of the Lower Grindelwald Glacier in Switzerland, which terminates in the Lütschine Gorge. An abnormal

[3] Earlier ice avalanches of Devdorak Glacier, for which little information exists, took place in 1776, 1785, 1808, and 1817 (N. Y. Dinnik: Sovremennye i drevnie ledniki Kavkaza (Present and Former Glaciers of the Caucasus), *Zapiski Kavkazskago Otdela Imp. Russ. Geogr. Obshchestva*, Vol. 14, 1890, pp. 282–417; reference on p. 353).

[4] The only highway between Tiflis and Ordzhonikidze (Vladikavkaz).

[5] L. A. Vardanyants: Geotektonika i geoseismika Daryala kak osnovnaya prichina katastroficheskikh obvalov devdorakskogo i genal-donskogo lednikov Kazbekskogo massiva (Geotectonic and Seismic Disturbances of the Dariyal Gorge as the Chief Cause of the Avalanche Catastrophes of the Devdorak and Genal-don Glaciers in the Kazbek Massif), *Izvestiya Gosudarstvennogo Geogr. Obshchestva*, Vol. 64, 1932, pp. 51–60.

[6] Dinnik, *op. cit.*, p. 408.

thickening of the glacier at the entrance of the gorge seems impossible, for, as I observed, its high face favors quick passage of the ice. Even if the dam actually formed, the outbursting water would carry down only that portion of the glacier within the gorge. At best, this hypothetical avalanche would amount to not more than a fiftieth of

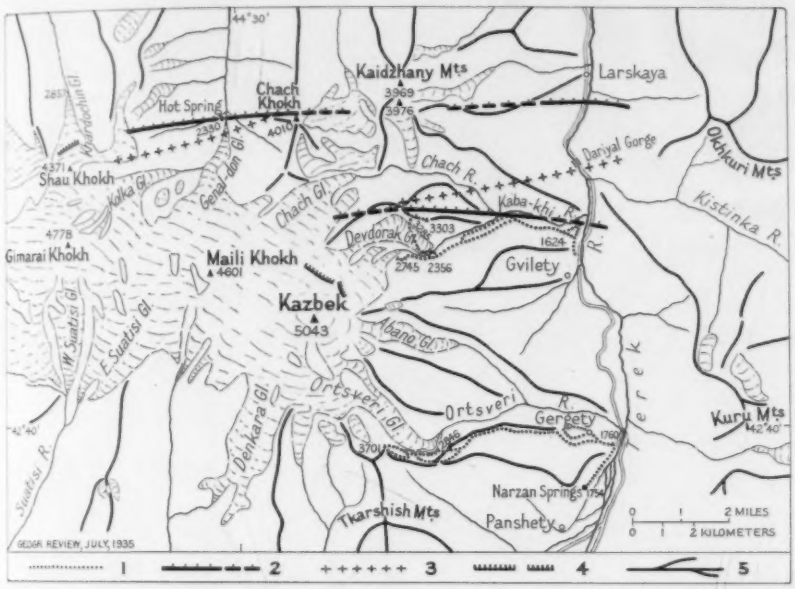


FIG. 1—Sketch map of the Kazbek region. Numbers have reference: 1, author's routes; 2, faults; 3, anticlinal axes; 4, rock cliffs; 5, major divides. The elevations to the northeast of Devdorak Glacier, 3285 and 3303 meters, have been named by the author Point Byrd, after Admiral Richard E. Byrd, and Punta Dainelli, after Professor Giotto Dainelli, respectively. To the southeast of Kazbek, elevation 3701 meters, Fusse Casteret, is named after Norbert Casteret, the cavern explorer (see "Les dénominations de quelques points inconnus dans la région de Kazbek, du Caucase Central," *La Géographie*, Vol. 63, 1935, pp. 286–298).

the glacier's total volume. This theory therefore fails to account for the catastrophic avalanches under consideration.

In a recent study, Vardanyants also came to the conclusion[7] that water did not play a significant role. In view of the fact that the Devdorak Glacier has an area of about 10 million square meters, an avalanche of this order would require a precipitation of 3 meters. Such a quantity of rain is improbable. Moreover, the effects of the precipitation could hardly be limited to the Devdorak region alone but would be felt in the neighboring region also. The Terek River would be swollen and the country around Ordzhonikidze inundated. There is no record of such an occurrence. Apparently the ice, snow, and rubble that crashed down the mountainside included no water.

Others have attempted a somewhat different explanation—that, as a result of increase in snow and ice, the Devdorak Glacier was able to

[7] *Op. cit.*

advance past an obstruction in its path. Khatisyan,[8] for example, suggested that the advancing Devdorak Glacier, guided by the course of the valley below it, impinged upon the rocky wall at its left, rising higher and moving with greater velocity on its left side than on its right until it reached a position necessitating a reversal of direction toward the right wall. The equilibrium would be sufficiently unbalanced to cause an avalanche. With this theory, as with the theory based on breaching of an ice dam by water, regardless of other objections, the volume of ice precipitated down the valley would be relatively inconsiderable.

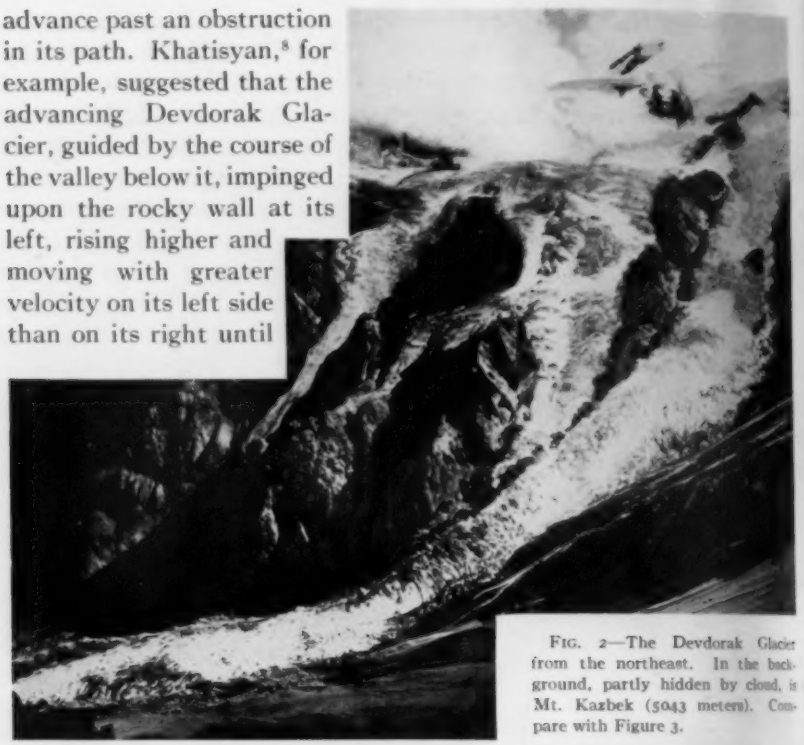


FIG. 2—The Devdorak Glacier from the northeast. In the background, partly hidden by cloud, is Mt. Kazbek (5043 meters). Compare with Figure 3.

Vardanyants, rather than explain these phenomena by external causes, has searched, and it seems with success, for an impulse in internal geotectonic events. He attributes the avalanches to seismic disturbances, of common occurrence in the region, and in this manner derives a solution both simple and adequate.

ARGUMENTS FOR THE SEISMIC EXPLANATION

After careful research, Vardanyants points out the existence of anticlines and zones of dislocation near these glaciers in the region of the Dariyal Gorge. He supposes that earthquakes with epicenters in the district comprising the zones of dislocation caused the disruption of the glaciers.[9]

[8] Dinnik, *op. cit.*, p. 408.

[9] The most recent earthquake with its epicenter in the Dariyal Gorge was recorded at Ordzhonikidze (Vladikavkaz) and Tiflis in 1915.

FIG. 3

FIG. 4

FIG. 3—The Devdorak Glacier from the mountain hut. September 21, 1897. Photograph by Harry Fielding Reid. See also photograph by Professor Reid in the *Pan-American Geologist*, Vol. 58, 1932, facing p. 377.

FIG. 4—View in the Dariyal Pass. Photograph by Harry Fielding Reid, September 20, 1897.

The essential factor in the occurrence of the heavy ice avalanches of the Devdorak Glacier is doubtless an ice cliff in the upper part of the glacier, at about 4200 meters, more than a kilometer in length and about 50 meters high. Considering the fact that the surface below it has an inclination of 40 to 50 degrees, it is understandable that an earthquake with its epicenter in the neighborhood may shake off from two and a half to five million cubic meters of ice. It seems quite obvious that such a mass, once it has begun rushing downward, will carry along that portion of the glacier lying below and thus increase enormously the volume of the original icefall. The total volume of the 1832 avalanche, as mentioned before, has been estimated by Vardanyants to have been about 15 million cubic meters.

Ice walls similar to that of the Devdorak Glacier appear on Vardanyants' photographs of Dzariu and Genal-don glaciers. This coupled with the fact that all three glaciers are on the north slope of the same mountain massif in an earthquake zone suggests strongly that their avalanches were similar.

A comparison of recorded periods of seismic disturbance[10] with the major avalanches in the Caucasus during the past century shows that severe earthquakes occurred in 1830–1832, 1840–1842, and 1853–1856, at the time of the Devdorak[11] and Dzariu avalanches. The first period brought 17 known quakes to the Caucasus, the second more than 50, and the third between 30 and 40.

A hot mineral spring only a few meters below the snout of the Genal-don Glacier adds further support to the seismic theory. Variation in both its quality and its volume, observed only a few hours before the catastrophe of 1902 by inhabitants of the valley, suggests a close relationship between zone of fracture, earthquake, and glacier avalanche. It has also been reported by the local people that shortly before the glacier avalanches large slides of rock were seen in the mountains in localities where such had never before been observed.

Conclusions

After this examination one is led to the belief that there will be future earthquakes and accompanying glacier avalanches in the Caucasus. Every moderate or severe quake with its epicenter in the region may precipitate a new catastrophe. But the fact must be reckoned with that a glacier, after serious avalanching, needs years for regeneration, and many years may elapse before it is again in a condi-

[10] I. Mushketov and A. Orlov: Katalog zemletryaseni rossiiskoi imperii (Catalogue of Earthquakes in the Russian Empire), *Zapiski Imp. Russ. Geogr. Obshchestva po Obshchei Geogr.*, Vol. 26, 1893.

[11] No earthquakes at the time of the earlier avalanches of the Devdorak Glacier have been recorded. However, Transcaucasus was not annexed by the Russian government until 1801, and the accumulation of seismological data was naturally a gradual process. It seems possible that these earlier ice avalanches were associated with unrecorded earthquakes.

tion to be disrupted.[12] The rapidity with which the ice may move downward once it is in an advantageous position has been demonstrated by the Devdorak Glacier. The mass of ice and rubble rushes down the valley at about 30 meters a second, the velocity of a hurricane! The entire fall takes place in less than four minutes, scarcely time to save one's life, to say nothing of property. The knowledge of the possible recurrence of avalanches makes a somewhat unpleasant outlook for the local inhabitants; for technical science is today, and probably will be in the near future, unable to prevent similar glacier avalanches.

[12] At the time of the Russian survey of 1880 the snout of Devdorak Glacier lay at 2296 meters. A hypsometric measurement by the writer in August, 1933, gave its altitude as 2356 meters and thickness of debris-covered ice as 70 meters. Taking into consideration the slope of the glacier, a vertical retreat of 60 meters in 53 years lies within the range of the general retreat during that period. See also, for further information on retreat, Werner Heybrock: Nekotorye rezultaty nauchnoi poezdki po tsentralnomu Kavkazu (Some Results of a Scientific Excursion in the Central Caucasus), *Izvestiya Gosudarstvennogo Geogr. Obshchestva*, Vol. 66, 1934, pp. 522–531; and Y. I. Frolov: Rezultaty obsledovaniya lednikov letom 1929 g. (Results of the Investigation of the Caucasian Glaciers Carried Out in the Summer of 1929), *Explorations des Glaciers de l'U.R.S.S., No. 1*, Service Hydro-Météorologique de l'U.R.S.S., Institut Hydrologique, 1934, pp. 57–63.

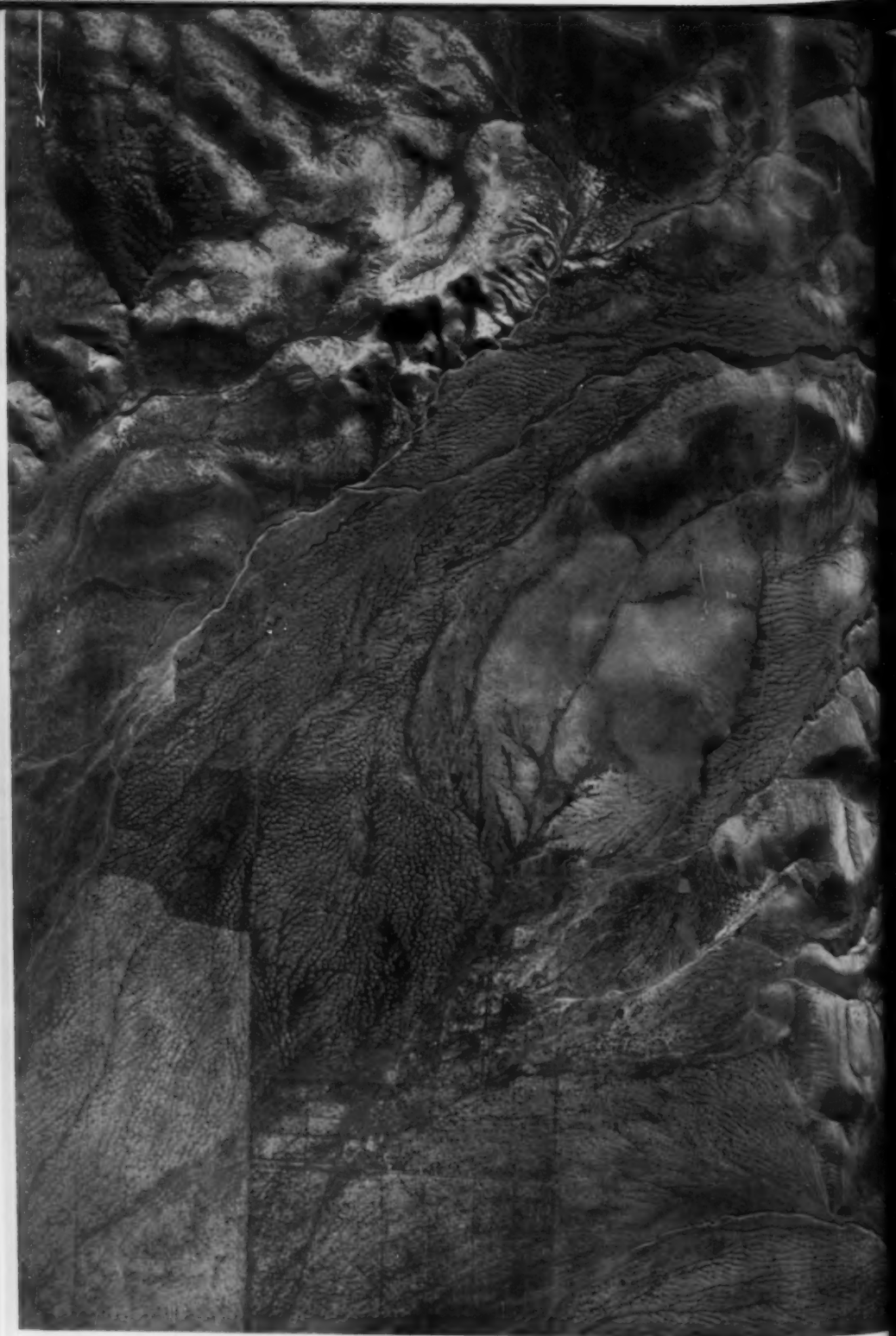


FIG. 1—Dissected alluvial fans in McClure Valley, California. (Photograph by Fairchild Aerial Surveys, Los Angeles)

UNIV. OF MICH.

VEGETATION AND SOIL MOUNDS

Frank A. Melton
University of Oklahoma

IN the October, 1934, number of the *Geographical Review*[1] Professor John L. Rich questioned the correctness of conclusions published in 1929 respecting the origin of the so-called "mounds" in northeastern Texas and adjoining parts of Arkansas and Louisiana.[2] The writer, following Le Conte, advanced the hypothesis that these features were residual hillocks that had been left between the gullies of a weak sandy soil and that had been subsequently rounded off by sheetwash.

Although Rich seems to deny the reality of this process, there is probably no occasion for controversy, since some of his photographs prove, and he admits, that at least a few of the "mounds" have originated in this way. For example, in his Figure 2, that which he calls "rill action" illustrates erosion by small rivulets. The writer's experience has shown that most of the features in the region under discussion are due to this process.

Vegetation without doubt plays an important part in guiding headward elongation of rivulets in many localities. It is unreasonable, however, to suppose that it directs headward erosion straight up the side of a hill, or that it can produce the intricate branching pattern commonly seen among gullies on the upper slopes of alluvial fans. In most cases plant growth clearly follows, and does not precede, the residual ridges between gullies in conforming to its environment. The chief function of clump vegetation lies in directing the segmentation of the residual soil strips by rivulets of secondary size. Although many examples could be shown of bushes forming the resistant nucleuses of hillocks, a greater number of such features probably exist without any protecting agent.

In order to distinguish patterns the observer must have a comprehensive view. Mosaics made in northeastern Texas from heights of five thousand feet or more commonly reveal an alignment of hillocks directly down the slope along rivulets tributary to the principal streams. This is illustrated by Figure 2, which shows the gullying and segmentation of an area of about three square miles near Longview, in northeastern Texas. It is probably also illustrated by Figure 4 (right section) in Rich's paper.

The writer pointed out in 1929 that different processes are operative in many places. He would now increase rather than diminish his

[1] J. L. Rich: Soil Mottlings and Mounds in Northeastern Texas as Seen from the Air, *Geogr. Rev.*, Vol. 24, 1934, pp. 576–583.

[2] F. A. Melton: "Natural Mounds" of Northeastern Texas, Southern Arkansas, and Northern Louisiana, *Proc. Oklahoma Acad. of Sci.*, Vol. 9, 1929, pp. 119–130.

FIG. 2

FIG. 3

FIG. 4

FIGS. 2, 3, and 4—Aerial photographs illustrating mound formation. Figure 2 is near Longview, northeastern Texas; Figure 3 is near Ahtanum Ridge, Washington; Figure 4 is at the western edge of the Kettleman Hills, California. (Photographs by Fairchild Aerial Surveys, Los Angeles.)

estimate of the number of localities where other factors—chiefly insolation, vegetation, wind, and sheetwash—have added their activity to that of running water.

As the theory of erosional origin in general has been questioned, it seems appropriate to introduce a few photographs from regions other than eastern Texas shedding new light on the origin of features similar to those under discussion. The writer has not visited the localities shown in Figures 1, 3, and 4; he consequently presents these views in the hope that others may be able to contribute additional information.

Figure 3 shows part of the outer edge of an alluvial apron on the south side of Ahtanum Ridge, about 15 miles southwest of Yakima, Washington. Elongate strips of soil have been segmented into isolated hills, which maintain the original linear arrangement between drainage lines. The ground is covered with snow.

Figure 1 is a photograph of partially dissected alluvial fans on the edge of McClure Valley in the southwestern part of Kings County, California. On the upper fan slopes the surface soil is found in elongate ridges, clearly of residual origin. These interlock with a system of branching gullies that have elongated themselves headward. Farther toward the lowlands the ridges have been segmented, and the characteristic mottled pattern of residual hillocks has resulted. In spite of the various agricultural activities on the farm lands of McClure Valley, which may be seen to the northeastward, the hillocks are still visible. They resemble those of Figure 4. Outcrops of tilted sedimentary rocks of Tertiary age at the edge of the Temblor Mountains form the uplands on the southwestern side of the view.

The effects of insolation on the south-facing slopes, and also the effects of wind, are in certain places combined with the protective influence of clump vegetation in modifying the results of erosion by small rivulets. In Figure 4, at the western edge of the Kettleman Plain, in Fresno County, California,[3] such a combination of processes appears, in which gullying is dominant. After stream erosion and sheetwash isolated the hillocks, wind abraded the exposed southern slopes.

[3] Sections 25 and 26, Twp. 22 S., Range 16 E.

THE CENSUS OF INDIA, 1931

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"OF all the nations that we know it is India has the largest population." These words of Herodotus,[1] quoted by Dr. J. H. Hutton, the Census Commissioner for India for 1931, are true today if Professor Willcox' estimate of the population of China is accepted.[2] The 1931 census credits India with a population of nearly 353,000,000, nearly one-fifth of the world's population. The census operation of India is by far the most extensive in the world. It is also the quickest and the cheapest. The 1921 census of England and Wales, for example, cost $45 per thousand of the population, whereas the expenditure in India was only $5 per thousand. The total cost of the 1931 census of India was nearly $1,800,000. The census reports occupy 28 volumes.

The total area covered by the census was 1,800,000 square miles, which gives a density of 195 persons to the square mile for all India.

This density however is a very variable factor appearing at the lowest as 6.5 persons per sq. mile in the mean density of Baluchistan, Chagai District of which has only one person to the square mile, and at its highest at about 2,000 persons per sq. mile in the most thickly populated parts of the south-west coast, the general density of Cochin State, including both the thickly populated coast lands and the almost uninhabited highlands, being 814.2 persons per sq. mile and reaching in one village the amazing maximum found in any purely rural population of over 4,000 persons to the sq. mile. There is, however, in Bengal an even higher general level of density, since the Dacca Division has a mean density of 935 persons for a population of 13,864,104, and reaches a rural density of 3,228 per sq. mile for Lohajang thana, and a mean density of 2,413 for Munshiganj sub-division which has an area of 294 sq. miles. Of the total population 256,859,787 represents the population of British India proper, the area of which is 862,679 sq. miles, and 81,310,845 that of the States with an area of 712,508 sq. miles.

If the population of India offers remarkable contrasts in density of distribution, so also does it in the ethnic types represented. Abbé Dubois more than a century and a quarter ago wrote: "A good observer will remark, under all general points of resemblance, as much difference between a Tamul and a Telinga; between a Canara and a Mahrata, as one would perceive in Europe between an Englishman and a Frenchman, an Italian and a German." Sir Edward A. Gait, speaking of the results of the latest census, says:[3]

[1] Census of India, 1931, Vol. I, India, Part I, Report, Delhi, 1933.

[2] Professor Willcox reduces a commonly accepted figure of at least 450,000,000 for the population of China (cf. G. B. Cressey: China's Geographic Foundations, New York and London, 1934) to 342,000,000. See W. F. Willcox: Increase in the Population of the Earth and of the Continents Since 1650, *in* International Migrations, Vol. 2, edited by W. F. Willcox (Publs. Natl. Bur. of Econ. Research, Inc., No. 18), New York, 1931, pp. 33–82.

[3] The Races and Languages of India, *Journ. Royal Soc. of Arts*, Vol. 81, 1932–1933, pp. 1065–1072, reference on p. 1066.

The Pathan and the Burman, the Sikh and the Bengali, the Gurkha and the Madrasi, the Bhil and the Naga, all differ from each other more than do the inhabitants of different parts of Europe. The same is the case with their forms of speech. Sir George Grierson's "Linguistic Survey of India," distinguishes 179 indigenous languages and 544 dialects. The latest census of India, which covers some areas not included in that survey, brings the total number of such languages up to 225.

In the words of the Census Commissioner, the people covered by the census "present every aspect from that of the latest phase of western civilization to that of the most primitive tribes."

The Taking of the Census

The taking of the Indian census is a triumph of organization. The census deals with the *de facto* population, i.e. the number of people actually in India on the census day. The aim is largely accomplished, though complete synchronization is not possible on account of the remoteness of some parts of the country and such difficulties to communication as are caused, for instance, by snows in the Himalayas. In 1931 the census date for Burma was fixed for two days before the day for India proper, the former being February 24 and the latter February 26. As in previous censuses, some difficulties were experienced. The Administrator of Bastar State, for example, was attacked by a tiger, which sprang on the front of his car "but finding the pace and the radiator too hot for him failed to make an end either of the inspector or his inspection." The Bhils would not have their houses numbered on superstitious grounds; Burman householders objected on artistic grounds. Politics interfered with the taking of the census in the cities of Ahmadabad, Broach, and Surat. On the other hand, some parties showed excessive zeal in registering as many adherents as they could in view of a communal franchise based on census returns. Feeling ran so high over the return of religion in the Punjab that some exterior castes, asked by one party to register as Hindus, by others as Sikhs, and even as Moslems, declared themselves Ad Dharmi or "adherents of the original religion," whatever that may be. The Sarda Act (Child Marriage Restraint Act), providing penalties for marriages of female children under 14 and of males under 18, which came into effect April, 1930,[4] and corresponding legislation passed in certain Indian states such as Baroda and Kashmir resulted in a definite decrease of accuracy in records of age and civil conditions. The Commissioner estimates the error in civil condition to be not less than 0.5 per cent and probably higher. Such instances of census difficulties need not, however, be multiplied.

In selecting the census date three things are kept in view. First, it should be as near as possible to the day of the previous census. Second, it should be a moonlight night between 7.00 p. m. and midnight

[4] For an account of the working of the act see Census of India, 1931, Vol. 1, Part 1, pp. 229–234.

TABLE I—DISTRIBUTION AND VARIATION OF THE POPULATION OF INDIA, 1921 AND 1931

	AREA *sq. mi.*	POPULATION *thousands*			POPULATION, 1931	
		1921	1931	INCREASE %	DENSITY *sq. mi.*	% TOTAL
British Provinces:						
Bombay	124	19,348	21,931	13.3	177	6.2
Bengal	78	46,702	50,114	7.3	646	14.2
Madras	142	42,319	46,740	10.4	328	13.2
The United Provinces	106	45,375	48,409	6.7	456	13.7
Punjab	99	20,685	23,581	14.0	238	6.7
Burma	233	13,212	14,667	11.0	63	4.1
Bihar and Orissa	83	33,995	37,678	10.8	454	10.8
Other British Provinces	231	25,220	28,407	11.4	123	8.1
Total British Provinces	1,096	246,856	271,527	10.0	248	77.0
Indian States and Agencies:						
Baroda	8	2,127	2,443	14.9	299	0.7
Hyderabad	83	12,472	14,436	15.8	175	4.1
Mysore	29	5,979	6,557	9.7	224	1.9
Kashmir	85	3,321	3,646	9.8	43	1.0
Travancore	8	4,006	5,096	27.2	668	1.4
Rajputana Agency	129	9,832	11,226	14.2	87	3.2
Other States and Agencies	371	34,349	37,907	10.4	102	10.7
Total States and Agencies	713	72,086	81,311	12.8	114	23.0
Grand Total	1,809	318,942	352,838	10.6	195	100.0

when the enumerators go through the houses in their blocks to verify their schedules. Third, occasions of large fairs or other gatherings should be avoided as far as possible—a difficult enough task in a country of the size and religious diversity of India. There is a Census Commissioner for India including Burma, and in each British province and Indian state a special census officer is appointed. The province or state is divided into districts that are in turn subdivided into charges, circles, and blocks. The block, usually of 30 to 40 houses, constitutes the sphere of the enumerator. The work is chiefly in the hands of local officers who perform duties of census in addition to their ordinary work. Most of them are members of the Land Revenue staff or village schoolmasters. This staff is carefully instructed some months before the census, and a preliminary enumeration is taken during three weeks or a month before the census date in which all the schedules are written out for the population in the blocks. The actual census, therefore, is merely a revision of the enumerator's books on the census night. The general immobility of the population permits a high standard of accuracy. Special measures are adopted for enumerating those who are in hospitals, asylums, jails, and camps or are in transit.

Population Density and Migration

Although the census data for the country as a whole are arranged by administrative divisions that do not correspond with "natural" units, provincial figures permit a grouping by which light is thrown on the effect of geographical causes on the distribution of population.[5] The maximum densities (Fig. 1) occur in the alluvial plains of northern India and in the fertile coastlands of Cochin and Travancore. As a general rule, the higher the rainfall, the more people there are to the square mile. Where the rainfall is uncertain and the cultivable area small, the population is thin. The proverbs of the people confirm the teaching of statistics. The peasant of Marwar, for example, knows when

> August's here, no sound of thunder,
> Sky is clear, and weather fine:
> Wife! 'tis time for us to sunder,
> You to your folk, I to mine.

The timely rainfall producing a bumper crop gives rise to the proverb in Bihar:

> One shower in Swáti—friend, behold
> The Kurmi's earrings turned to gold!

Where the rainfall is low, however, the density in the canal-irrigated areas can be maintained and increased. The irrigated areas of the Punjab and the irrigated areas in Sind produce valuable crops today where formerly there was desert. It is interesting to note that in these areas the idea of kismet, an idea deep in the mind of every Hindu, is weakening. The Punjab peasant in the canal colonies sees Nature being subdued and yielding her increase not "as God wills" but as man labors. This new outlook is well expressed in the remark of a colonist, "Where the water is, there is God."

The extreme densities have already been referred to. It may be noted that when the thickly populated areas are examined in detail the rate of increase is found to be greater in their less populated and less fertile parts. Thus in the three natural divisions of Travancore, lowlands, middle areas, and highlands, the increase in population is greatest in the highlands, the least fertile area. Similarly, in Bengal the greatest rate of increase is in the Chittagong Hill Tracts and in Madras in the Nilgiris. It would therefore appear that where the population is already dense it is spreading to the less profitable lands.

Migration accounts to a small extent for the increases shown in the

[5] Compare the Report of the Census of India, 1901 (Vol. 1, Part I, Calcutta, 1903, pp. 3–12), which made use of a system of natural divisions based chiefly on meteorological characteristics. A revised scheme based primarily on political divisions subdivided "in cases where the climatic features require it" appeared in the Report of the Census for 1911 (see Vol. 1, Part 1). See also J. N. L. Baker: Notes on the Natural Regions of India, *Geography*, Vol. 14, 1927–1928, pp. 447–455; L. D. Stamp: The Natural Regions of India, *ibid.*, pp. 502–506; and F. J. Richards: Cultural Regions in India, *ibid.*, Vol. 15, 1929–1930, pp. 20–29.

table above, although, as is well known, Indians are home-loving people. The Hindu, if he leaves his native place permanently, suffers many disadvantages. He is cut off from his former group, i.e. that part of his caste with whom he can eat, smoke, and intermarry. He

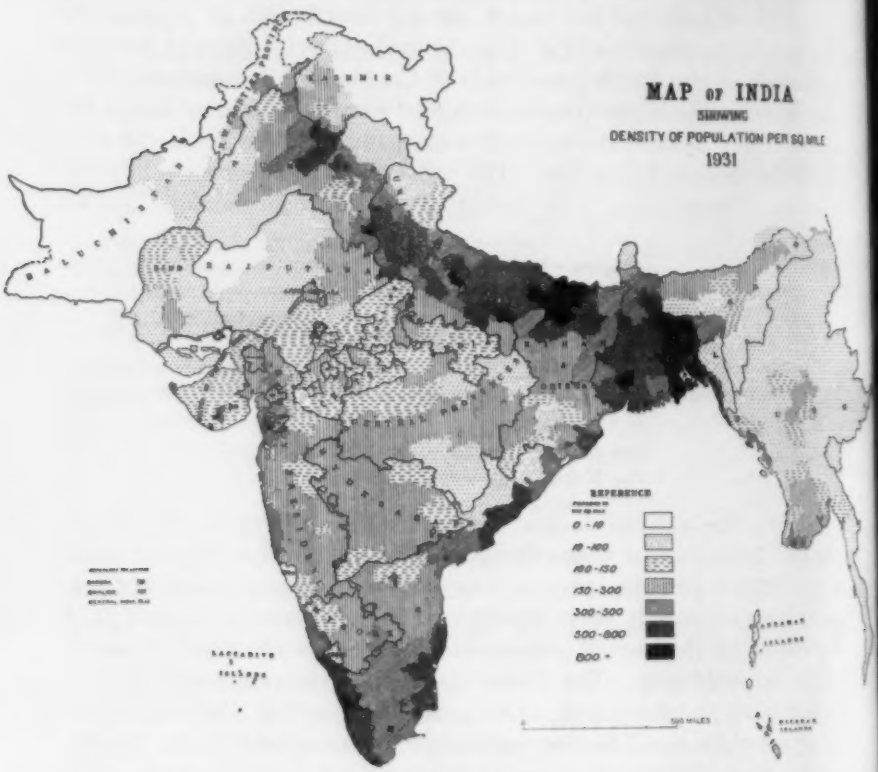

FIG. 1—Map of India showing population density according to the census of 1931. Reproduced on a reduced scale from the census report.

finds it extremely difficult to enter a new group. When he dies there will be no relative to perform the all-important funeral ceremonies. His body may have to be removed to the burning ghat by scavengers. Moreover, if he should return home, he is suspected of having broken the rules of his caste, and he may find it hard to regain his old position. It has been pointed out from time to time that on the west coast of India certain rivers must not be crossed, especially by women. In northern India, owing to the practice of hypergamy and a rising social status from east to west among Hindus of several castes, there is a migration of women westwards. There are penalties, too, for a journey across the ocean, "the black water." The Moslem is less circumscribed by caste prejudice, but he, too, is reluctant to go far from his ancestral home. In addition to social reasons there is for him the economic

reason resulting from the fact that the principal occupation is agriculture. He is bound to the soil he cultivates.

Internal migration assumes various forms. It may be purely casual, such as the minor movements between neighboring villages mainly for marriages or other social events. It may be temporary—migration on public works such as canals and railways or pilgrimages. It may be periodic—the migration due to the seasonal demand for labor at the time of the rice harvest in Burma and the wheat harvest in Upper India; the movement to Bombay from the Deccan and to Calcutta from Bihar and the United Provinces for the mills; the migration of itinerant traders from Afghanistan into India. There is also quasi-permanent migration, such as that of government officials and domestic servants, and of the Marwari traders and moneylenders, who in their old age almost always return to their homes in Rajputana. Lastly there is the permanent migration that is in the nature of colonization. During the last decade, for example, the population of Bikaner increased 41.9 per cent by immigration for the construction work on irrigation projects. The movement of cultivators from the congested districts of the Punjab to the canal areas in Lyallpur and other irrigated districts are also examples of this class of migration.

There is in parts of Assam a large increase in the Moslem population from Bengal. These eastern-Bengal immigrants are good agriculturists, hard-working, and they spend money freely, at any rate on litigation. The Assam Census Report of 1931 describes this permanent migration thus:

> Probably the most important event in the province during the last twenty-five years—an event, moreover, which seems likely to alter permanently the whole future of Assam and to destroy more surely than did the Burmese invaders of 1820 the whole structure of Assamese culture and civilization—has been the invasion of a vast horde of land-hungry Bengali immigrants, mostly Muslims, from the districts of Eastern Bengal and in particular from Mymensingh.

Migration out of India[6] is largely restricted by the countries concerned. The early marriage universal in India is also a great deterrent to emigration. Emigration began after the abolition of slavery in 1834, and there were about two and a half million Indians resident outside India at the time of the last census. On the other hand, there were nearly three-quarters of a million foreigners living in India, of whom nearly 595,000 were Asiatics, 118,000 Europeans, and 17,000 others. There is thus a balance of migration against India of 1.75 millions. The detailed figures are given in Table II. Since the Emigration Act of 1922 the government of India has controlled the emigration of unskilled labor.

The small effect of migration is seen in the proportion of persons

[6] See my paper "Indian Migration" in "International Migrations," Vol. 2 (see footnote 2), pp. 591–616.

TABLE II—DISTRIBUTION OF FOREIGN-BORN BY CONTINENTS

BORN IN	1931	1921	VARIATION
Asia	595,078	472,576	122,502
Europe	118,089	121,064	−2,975
Africa	11,408	4,719	6,689
America	4,455	3,446	1,009
Australasia	1,516	1,683	−167
Total	730,546	603,488	127,058

born in the province or state where enumerated. For the whole of India this was 9979 in every 10,000 of the population (or only 21 born elsewhere). The provincial figures range from 9943 in Madras to 8477 in Assam and 7629 in the small province of Coorg.

Seasonal vicissitudes, crop failures, and famine and the epidemic disease that is often a concomitant are reflected in the censuses. In the census of 1921 the effect of the influenza epidemic of 1918 was as clear as the noonday. No less than 12,000,000 are estimated to have died from this cause. The large part of the deaths that occurred in the space of three or four months exceeded by two millions the total deaths from plague during the previous 20 years and more than doubled the deaths attributable to the famines of the period 1897–1901. The case mortality from influenza in 1918–1919 was roughly estimated at 10 per cent, and on this basis the total number of persons affected by the disease was about 125,000,000. This had a considerable effect on the general health of the population. The birth rate dropped below the death rate in 1918 and 1919 and exceeded it only slightly in 1920. The 1931 census, on the other hand, showed the effect of a decennium comparatively free from any vicissitude. Table III gives the increase of the population during the last 70 years.

TABLE III—THE POPULATION OF INDIA AT EACH CENSUS

(*In millions*)

YEAR	POPULATION	INCREASES DUE TO		REAL*	INCREASE %
		NEW AREA	IMPROVEMENT IN METHODS		
1872	206	..	..	..	...
1881	254	33	12	3	1.5
1891	287	6	3	24	9.6
1901	294	3	..	4	1.4
1911	315	2	..	19	6.4
1921	319	..	..	4	1.2
1931	353	..	..	34	10.6

*The real increase is obtained by adding to the previous census the population enumerated in new areas and by improved methods and subtracting this from the subsequent census figure.

The High Birth Rate

The birth rate in India is very high—40 per mil; in some provinces it is even higher. Combined with the high birth rate is an unusually high death rate, which results in a comparatively low survival rate. Early marriage, infanticide, and uneducated midwives are mainly responsible for this state of affairs. Even if a child survives birth, its chance of growing up is uncertain: in 1932, a healthy year, for every 1000 children born 179 died under the age of one.[7]

The figures for the 1931 census show that of the females of marriageable age only 6 per cent are unmarried, though some check is afforded by the ban on widow remarriage in the higher Hindu castes (11 per cent of the total marriageable women). The average size of families in India arrived at by sampling is given according to religion in the following table, together with the results from Baroda, where careful inquiries were made.

Table IV—Average Size of Families by Religion

Religion	Children Born Alive		Percentage Survivors	
	India	Baroda	India	Baroda
Hindus	4.3	6.7	69.7	60.7
Moslems	4.1	5.6	69.9	60.6
Christians	5	..	76.8	...
Parsis	4.6	4.4	70.7	69.2
Jews	3.8	..	71.6	...
All religions	4.2	5.7	70.0	60.4

If the size of families is taken according to the occupation of the father, men of religion and men living on their incomes have the largest families, viz. 5.2 and 5 children to a family. Among agricultural laborers and carpenters the average is 4.3. One striking fact from the samples is that the average family among doctors, lawyers, and teachers is 3.7, and here the survival rate is the highest—760 per 1000. Truly doctors if they cannot cure themselves can yet cure their children! Civil servants have on an average 3.9 children and the army 3.6. However, in India today birth control is making some headway. According to Mr. Darling, among the Sikhs of the central Punjab the practice began 10 or 12 years ago and is increasing fast.[8]

As my informant says "a new current has set in and is on the swell." On asking one of those concerned why he did not desire more children he received the reply "because more sons will have no land to cultivate and I don't wish to make beggars

[7] M. L. Darling: Wisdom and Waste in the Punjab Village, Oxford Univ. Press, 1934, p. 281.
[8] *Op. cit.*, pp. 212–213 and 309–313.

of them all." He then quoted the proverb "Too much rain reduces the crop; too many sons bring reproach." The remark of another peasant explains the practice in a nutshell. "Every son," he said, "comes with a share written on his forehead!"

This, however, is in advanced areas—in the irrigated lands of the Punjab. Young men of the educated classes, when asked what they propose to do if Heaven should crown their union with increase, have replied with more or less directness that in the present depression the contingency need not be contemplated. Today in India economics is knocking at the door of ethics, and orthodox opinion is very slowly changing its attitude. As the women of Sialkot in the Punjab said, "There is great change; a new wind blows."

With the present birth and death rates the population will double itself in 94 years as against 49 years for Japan. Japan has an occidental death rate combined with an oriental birth rate, which is quite different from the case of India.

The Scarcity of Women

Only a few of the many interesting features of Indian demography as revealed in the census can here be touched on. One such, a feature showing a marked regional trend, is the proportion of the sexes. For India as a whole the ratio of women to men is 94 : 100. Toward the north and west the disparity of the sex ratio becomes very striking indeed, and women become scarcer and scarcer relatively to men. This is brought out in the following table:

Table V—Ratio of Women to Men

Group I	Ratio	Group	Ratio	Group II	Ratio	Group III	Ratio
Baluchistan	72	Assam	90	C. India Agency	95	Central Provinces	101
Delhi	72	Kashmir	90	Mysore	95	Bihar and Orissa	103
Sind	79	Rajputana	91	Hyderabad	95	Madras	103
Punjab	83	Bengal	92	Burma	96	Orissa	110
N.-W. Frontier	85	Oudh	93	Berar	96		
Gwalior	89	Bombay	93	Bihar	99		
Agra	89	Baroda	94				

More males are born than females in every province in India. It is true that the reporting of the female births may be incomplete. But the inequality is not enough to balance the excess of male births reported. The recent census report points out that the female infant is better equipped by nature for survival than the male but the advantage that she has at birth is neutralized in infancy by neglect and in adolescence by the strain of early and frequent childbearing. In many parts of India daughters require dowries, and marriages must be arranged before the girls reach puberty. "So strong indeed is the

prejudice against the birth of daughters," says the 1931 Census Commissioner, "that abortion is reported to be sometimes practised if the child in the womb is foretold to be a girl." The Census Superintendent of Rajputana in referring to the Kachwaha clan of Rajputs at the last census points out that poverty prevents the payment of the substantial wedding dowry usually demanded and the family is traditionally haunted by the prospect of unmarried girls. A studied neglect of female infant life has thus grown up, even if deliberate infanticide can seldom be established. A university graduate mentioned the case of his grandmother, who had four sons and thirteen daughters but allowed only one of the thirteen to survive birth: the others were given an overdose of opium. His mother got rid of one of her two daughters in the same way, but her husband compelled her to do penance for two years. This kind of thing is getting rarer, but there still is small regard for girl babies. The midwife gets one rupee for a boy but only eight annas for a girl and sometimes nothing at all. There is a proverb "Feed son and bullock well: both are bread-winners."

The statistics of females per 100 males have been examined for the 1901, 1911, and 1921 censuses for those castes that have a tradition of female infanticide and compared with those castes that have not. In the former group are the Jat (Hindu), the Rajput (Hindu), and the Gujar, and these have been compared with the Jat (Mussulman), the Rajput (Mussulman), and the Brahman, selected as examples of the other group. The results show a remarkable difference and lead to the definite conclusion that in some parts of India today there is the continued deliberate destruction of female infant life either by active or by passive means. Professor Willcox has recently shown that in the provinces from which returns of persons classified by sex were received in the 1910 Chinese census nearly 56 per cent of the reported population were male. (The corresponding figure for India is 52 per cent.) He concludes that the only way in which the disproportion between the sexes indicated can be explained is by the neglect of females, especially female children, or by female infanticide on a large scale, or more probably by a combination of the two influences.

Mortality and Expectation of Life

The mortality tables constructed by Mr. L. S. Vaidyanathan, actuary of the 1931 census, show the comparative rates of mortality during the last 50 years. The main conclusion arrived at is that mortality among women between 15 and 40, the reproductive ages, is still very high and higher than in 1901. "Taking female mortality as a whole," writes Mr. Vaidyanathan, "it can be stated that the deterioration which set in from 1901 onwards has not yet taken a definite turn

towards improvement. Whereas in the case of males the position in 1931 with respect to vitality was such as to bring it back very nearly up to the high level reached in 1891, the female vitality, however, does not indicate any recovery of the lost ground." The heaviest mortality among females is shown by the Sind, Baluchistan, and North-West Frontier Province group. This is probably due, as stated by the Government Actuary, to the strict purdah observed by women in this group, whose population is mainly Mohammedan. The mortality in Bengal does not show any tendency to improvement, Bengal, Assam, and Rajputana being inferior to the rest of India in vitality.

The expectation-of-life tables are exceedingly interesting. Not only does the comparative expectation of life province by province or area by area for both females and males arrest attention, but the comparison between India and other countries is also of special interest. At age 10 the expectation of life at the last census was 36.38 years for males (35.46 in 1901) and 33.61 for females (34.40 in 1901) as compared with 54.64 years for males and 57.53 for females in England and Wales in 1921. At age 0 (i.e. at the time of birth) the expectation of life for males was 26.91 years and for females 26.56 years. The corresponding figures for England and Wales for the 1921 census are 55.62 years and 59.58 years.

Literacy

The 1931 census shows that literacy is still far from being widespread. The percentage above the age of 5 that are literate in the sense of being able to read and write a post card in their own vernacular is 15.6 for males and 2.9 for females or 9.5 for both combined. There has been undoubted progress in the present century, as the following percentages for the various censuses show. But the solution

Table VI—The Progress of Literacy for Age 10 and Over

%	1901	1911	1921	1931
Males	12.9	14.0	16.1	17.4
Females	0.9	1.3	2.3	3.1

of compulsory primary education will take time and will cost annually at least 73,000,000 dollars. It will not be welcomed by agriculturists, who number seven-tenths of the total population.

Religion, Caste, and Race

The data on religion and caste are of great importance. Society in India is organized largely on the basis of religion and caste, especially among Hindus. Dr. Hutton, the census commissioner, puts it thus:

It is not in its devotional aspect that the census is concerned with religion, . . . social conduct is much influenced by practices which may not be in themselves religious but which are subject to religious sanctions. The age of marriage, the practice of remarriage, the observance of purdah, the occupations of women, the inheritance of property and the maintenance of widows, even diet, to name a few obvious cases, vary according to the caste and the religious community of the individual. The time will no doubt come when occupation will serve the purpose at present served by religion and caste in presenting demographic data, but that time is not yet, and at the present moment their barriers have not so far decayed that their social importance can be ignored for public purposes, though progress in this direction may well prove much faster than one anticipates.

It is sometimes difficult to get at a man's religion. Some Hindus and Mohammedans observe both rituals in their ceremonies. The Satpanthis of Gujarat, who are Hindus, Kunbis by caste, follow the Atharva-Veda of the Hindus but worship at the tombs of Moslem saints at Pirana. They observe the Ramadan, repeat the Kelima, and bury their dead as Moslems do but with both Moslem and Hindu prayers. They keep Holi and Dewali like Hindus, and their marriages are conducted by Brahmins. The Commissioner of the Census regards them as Hindus socially but Moslems by religion. A similar case is that of the Christian Kolis of Bombay, who combine the worship of idols with the worship of the Christian Trinity, figures of Hindu godlings being kept behind the altar and covered with a cloth when a priest comes to celebrate Mass.

To define Hinduism is no easy matter. Sir Denzil Ibbetson described it as a hereditary sacerdotalism with Brahmins for its Levites, preserved in its vitality by the social institution of caste. Mohammedans are not difficult to define, nor are Christians and Parsis. The Jains and the Sikhs cannot be easily defined, since a few of both call themselves Hindus. The daughter of a Sikh ruler can marry a Hindu of the house of Nepal, and Hindus can enter the Golden Temple at Amritsar, which is normally barred to Moslems and Christians; and cases are known in which a Sikh father has brought up one son as a Hindu and another as a Sikh. In general, the Sikhs protest that they are not Hindus, and this is particularly true of those Sikhs who are the backbone of the Sikhs in the Indian army—Akali Sikhs. The Jains have extreme views regarding the sanctity of animal life. They usually take their evening meal before sunset in order to avoid any chance of eating an insect during the meal. Poisonous snakes and scorpions are caught and brought sometimes to the University College area here, where they are let loose in the cactus hedges, much to my inconvenience and to the danger of students! I have seen a flock of sheep being sent to a *panjrapole* (animal asylum) by a devout Jain who had purchased them on the spot when he knew that the flock was going to a butcher. The Jain religion, however, has a firm hold on its believers, and in Ahmadabad well-to-do Jains have done much to

educate the children of their poorer brethren and to assist those of their caste liberally in a university career.

At the census of 1931 there were 50,000,000 in the depressed classes, or 14 per cent of the total population. By depressed classes is meant those who are Hindus but are outside the pale of Hinduism—the untouchables. Christians have increased more rapidly than adherents of any other religion during the last 25 years, largely by reason of conversion of the backward classes. Buddhists are increasing steadily, but Jains and Zoroastrians (Parsis) are decreasing. The fertility of the Parsis may be lowered by too much inbreeding. The following table shows the percentage strength of the various religions.

TABLE VII—PROPORTIONAL STRENGTH OF MAIN RELIGIONS

RELIGION	(*Percentages*)					
	1881	1891	1901	1911	1921	1931
Hindu	74.3	72.3	70.4	69.4	68.6	68.2
Jain	0.5	0.5	0.5	0.4	0.4	0.4
Buddhist	1.4	2.5	3.2	3.4	3.7	3.7
Sikh	0.7	0.7	0.8	1.0	1.0	1.2
Moslem	19.7	20.0	21.2	21.3	21.7	22.2
Christian	0.7	0.8	1.0	1.2	1.5	1.8
Others	2.7	3.2	2.9	3.3	3.1	2.5
Total	100	100	100	100	100	100

Under others are included Parsis, who are only .03 per cent of the total; Jews, who are .01 per cent; and tribal religions, which have decreased from 3.3 per cent in 1911 to 2.4 per cent in 1931. "Hindu" includes the exterior castes or depressed classes.

CASTE

No other country has anything like the caste system of India. On the one hand it has been described as leading to "a degree of social disunity to which no parallel can be found in human history" while on the other "it has produced cultural and political stability."

In the 1931 census no return of caste was insisted on from Moslems, Christians, Sikhs, Jains, Buddhists, and Aryan or Brahman Hindus, but if given it was recorded. The Census Commissioner, however, notes that caste is by no means always ignored by Christians. The spirit of exclusiveness underlying caste is universal. It differs in different places and among different communities, but it has two very prominent characteristics—endogamy and commensalism. In 1935 caste is still the foundation of India's social fabric. A member of the caste may not marry outside the caste, and usually he must marry within a particular endogamous division of the caste. Every Hindu

is born into a caste, and his religious, social, domestic, and even economic life from birth to the grave is determined by it. In the 696,831 villages of India today spiritual and social factors connected with caste and traditional occupation are all-important.

In journeying by trains, in the bustle of city life, in reformed and progressive circles it may seem nearly extinct, but it is still there, an institution forming the people into groups for the purposes of daily life, which though at times provoking bitterness that does not seem native to it has on the whole certain conveniences; and until the mass of the people outgrows it a very real demological interest attaches to it.

It is difficult to convey to the Westerner exactly what caste in India is. Let us suppose that the first Smith took his name from the "smooth" weapons that he made for his tribe. The cardinal doctrine of the community would be that, bound by common descent, Smiths must always marry Smiths, and in no circumstances could they marry Browns, Joneses, Rockefellers, or Morgans. This entire caste would be split into an indefinite number of "in-marrying" subcastes—baking Smiths, brewing Smiths, temperance Smiths, Smiths with double-barreled names with or without hyphens, Democratic Smiths and Republican Smiths, Smiths of Virginia, Smiths of Massachusetts, and senator Smiths—all united by the absolutely unbreakable law forbidding the members of any of these subcastes to marry outside the circle or subcaste. Thus the Democrat or Free Trade Smith could not think of marrying a Protectionist Miss Smith. In addition, another principle would be at work breaking each subcaste into minor subcastes forming a graduated scale of social distinction. Thus the Hyphen Smiths might again be divided into Methodist or Episcopal Smiths or Roman Catholic Smiths and take rank in that order. Now the rule of these three groups would be that a member of the highest group could marry a girl of his own group or of one of the two lower groups. A woman could in no circumstances marry below her and in most circumstances she would marry above her. There would also be great restrictions regarding food and dining together.

The foregoing is, in somewhat unconventional language, an attempt to describe in Western terms the importance of caste in India. The alternative of not adhering to caste restrictions is excommunication or being outcasted, which means that the outcaste cannot dine with his relatives or other members of the community publicly, nor can his sons get wives from his community.

Since caste is peculiar to India and so deeply rooted therein, its beginnings must almost certainly be found in the country itself. The Census Commissioner (Dr. Hutton) traces it back to totemistic practices of the truly aboriginal pre-Dravidian population. "The genius of India, her strength and weakness, are peculiar to herself."[9]

[9] A. V. Williamson: The Races of India: A Restatement, *Geography*, Vol. 19, 1934, pp. 21–28; reference on p. 26.

This brings us to the question of race, on which Dr. Hutton is eminently qualified to speak. So much work has been done since the 1901 census report laid the foundation of study of the racial composition of India that "the whole complexion of the problem" has been changed. It is not possible to analyze here the Commissioner's remarkably condensed summary of the archeological, anthropological, and cultural evidence of the stages by which India has been populated. I shall simply quote from his recapitulation.

> The earliest occupants of India were probably of the Negrito race, but they have left little trace on the mainland of the peninsula. The Protoaustraloids who followed them . . . may claim to be the true aborigines on the ground that their racial type was ultimately fixed in India. They were followed by an early branch probably of the Mediterranean race, speaking an agglutinative tongue from which the present Austroasiatic languages are derived, which migrated down the Ganges valley . . . This early branch of the Mediterranean race may have carried with it the beginnings of culture with a rudimentary knowledge of agriculture. They may also have taken the practice of erecting rude stone monuments and perhaps of primitive navigation. This migration was followed by a later immigration of civilised Mediterraneans from the Persian Gulf, but ultimately from eastern Europe, who brought with them the knowledge of metals but not of iron and were followed by later waves of immigrants and a generally advanced culture, which maintained a connection with the cities of Mesopotamia and evolved or developed the prehistoric civilisation of the Indus valley and in all probability a similar civilisation in the Ganges valley. All these immigrants were of the dolichocephalic type, but mixed with this last race, possibly even with the first comers but in any case as later settlers, was a brachycephalic element coming ultimately from the Anatolian plateau in the form of the Armenoid branch of the Alpine race. The civilisation which arose in India under the auspices of these races had developed by the end of the 4th millennium B. C. a high standard of comfort, art and sanitation in city life, and a religion which bears many resemblances to the earlier religions of the eastern Mediterranean. The language in use was probably Dravidian, and there was a pictographic script analogous to those in use in prehistoric Mesopotamia. This civilisation was flooded in the west during the third millennium B. C. by an immigration from the Iranian plateau and the Pamirs of a brachycephalic race . . . , the main course of which migration went down the west of India and across the Mysore plateau to the south . . . Meanwhile in the extreme east of India other movements were going on, as there was a widespread race movement of the southern Mongoloids southwards to the Bay of Bengal and into Indonesia, which had some reflex influence on India from the east. Finally about 1500 B. C. came the Indo-Aryan migration into the Punjab, which first occupied the area between the Indus and the Jamna and later sent colonies across the Jamna into Hindustan. These imposed themselves upon the surviving civilisation there, which so reacted to this powerful stimulant as to produce from the combined material the philosophy, religion, art and letters that were the glory of ancient India, though it yet remains for the descendants of those early races to accomplish the vision of the Bhavishya Purana and unite the peoples of India in the fulness of time to be of one caste, a united nation.

CHENIERS OF SOUTHWESTERN LOUISIANA

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SEVERAL long, narrow, sandy ridges run roughly parallel to the coast of southwestern Louisiana. Rising slightly above surrounding marshes, lakes, and watercourses, all essentially at sea level, these low ridges form the most conspicuous topographic features of the region. Sharply localized, well drained, and fertile, they support naturally a luxuriant vegetational cover in which large evergreen oaks form so striking a part that, quite deservedly, the ridges have been called *cheniers*[1] by their Creole inhabitants. Many of the cheniers have been cleared. Cotton fields cover large parts of the highest and most accessible; those lower and more distant form bases for grazing, trapping, hunting, and fishing. Where they are served by roads or navigable waters, the population is relatively dense and prosperous. It is not the purpose of this paper, however, to consider cheniers in their cultural aspects. We are here concerned with their origin, a history involving several of the dominant geologic processes affecting the Gulf Coast during Quaternary time.

The entire Gulf Coast of the United States is a splendid exhibit of the consequences of active submergence. The mouth of practically every river is estuarine. From the Caloosahatchee, of southern Florida, to Baffins Bay, of southern Texas, the coast is marked by a dozen or more large bays and a much larger number of less conspicuous drowned river mouths. The subsidence causing this condition is so rapid that in the entire distance only two rivers, the Mississippi and the Appalachicola, have been able to build deltas protruding into the Gulf. The Mississippi has done so because of its enormous size and load, the Appalachicola because it drains an anticlinal region undergoing active uplift. The absence of deltas along the Gulf Coast might not be particularly significant were the streams clear and their burdens small, but the opposite is the case. Any comparatively short period of crustal stability would witness not only the rapid filling of their estuarine mouths but the growth of deltas into the Gulf as well.[2]

The effects of submergence extend well inland. Practically every stream immediately inland from the coastal marsh zone flows down

[1] In older publications and, with reference to Grand Chenier as a ridge, on the Louisiana State University Map of Louisiana by S. H. Lockett, 1891, 1 : 633,600, the spelling is *Cheniere;* elsewhere and on all official maps it is *Chenier*, as in local usage; from the French *chêne*, oak.

[2] Recognized by many earlier writers. See, for example, W J McGee: The Lafayette Formation, *U. S. Geol. Survey, 12th Ann. Rept.*, 1890–1891, Part 1, pp. 347–521, reference on pp. 375–377; G. D. Harris and A. C. Veatch: A Preliminary Report on the Geology of Louisiana, *Geol. and Agric. [of Louisiana], Part 5*, Louisiana State Exper. Sta., Baton Rouge, 1899, pp. 37, 109–111, and 117–118; N. S. Shaler: Evidences as to Change of Sealevel, *Bull. Geol. Soc. of America*, Vol. 6, 1895, pp. 141–166, reference on pp. 152–153; and R. B. Dole and H. Stabler: Denudation, *U. S. Geol. Survey Water-Supply Paper 234*, 1909, pp. 78–93, reference on p. 83.

a wide flood plain bounded sharply by cliffs on each side. The Mississippi flood plain in southern Louisiana averages about 30 miles in width. The flanking cliffs rise from 10 to more than 150 feet and are notched by numerous tributaries that entered the river when it stood much lower in relation to bordering uplands. Alluviation concomitant to subsidence has not only built up the broad flood plain but has also extended up tributary notches so that a pattern of "alluvial drowning" exists that is fully as striking as are the outlines of Chesapeake Bay. The Suwanee and Escambia rivers of Florida, the Pascagoula of Mississippi, and every other master stream westward in Louisiana and Texas exhibit precisely the same condition.

It is not surprising that active subsidence should characterize the whole Gulf Coast region. It is the landward side of the most active geosyncline in North America. Since the beginning of the Tertiary a deposit some 20,000 feet thick has accumulated in southern Louisiana.[3] Quaternary deposition has been so rapid that fresh cypress wood is found commonly to depths of as much as 1800 feet in southern-Louisiana oil wells and Recent faunas at depths of 2400 feet, and Pleistocene at 3000, have been reported.[4] Even this rate of Quaternary sedimentation is not surprising. The Mississippi River daily carries a burden of more than a million tons of sediment[5] to the Gulf, and practically all of it settles to the bottom within a few tens of miles. If this rate were extended back to the beginning of the Comanchean, the accumulated sediment would amount to a solid large enough to cover the entire state of Louisiana to a depth of 121 miles![6] There can be no doubt that we are here dealing with a force sufficient to account for a long and continuous record of coastal submergence.[7] If the strength of the earth's crust were sufficient, this load might well be looked on as the cause of the Gulf of Mexico. The

[3] The Comanchean and Cretaceous add another 8000 feet. For discussion and bibliography see H. V. Howe and C. K. Moresi: Geology of Iberia Parish, *Louisiana Dept. of Conservation Geol. Bull. No. 1*, 1931, pp. 86–92; D. C. Barton and Maude Hickey: Gulf Coast Geosyncline, *Bull. Amer. Assn. of Petroleum Geologists*, Vol. 17, 1933, pp. 1447–1458; the same: The Continental Margin at Texas-Louisiana Gulf Coast, *Trans. Amer. Geophys. Union, Fourteenth Ann. Meeting, April 27, 28, 29, 1933*, pp. 16–20; and N. H. Darton: Guidebook of the Western United States, Part F, *U. S. Geol. Survey Bull. 845*, 1933, p. 19.

[4] G. D. Harris: Underground Waters of Southern Louisiana, *U. S. Geol. Survey Water-Supply Paper 101*, 1904, pp. 25–26; *idem:* Oil and Gas in Louisiana, *U. S. Geol. Survey Bull. 429*, 1910, pp. 58–59, 170, 174, and 178.

[5] Nearly all estimates of the sedimentary burden of the lower Mississippi are based on the work of A. A. Humphreys and H. L. Abbot: Report upon the Physics and Hydraulics of the Mississippi River, *U. S. Army, Corps of Topographical Engineers Professional Papers No. 4*, 1861, reprinted as *Professional Paper No. 13*, 1876. More recently the question is discussed by D. O. Elliott: The Improvement of the Lower Mississippi River for Flood Control and Navigation, U. S. Waterways Exper. Sta., Vicksburg, 1932, Vol. 1, pp. 127–137. These appear to be minimum values because they are based wholly on sediment carried in suspension. The Mississippi River Commission is now undertaking estimates of bed-load transportation. Preliminary observations suggest that when this factor is fully accounted for the total burden will be found to be more than twice that of the earlier estimates, quoted above.

[6] Howe and Moresi, *op. cit.*, pp. 122–123.

[7] W J McGee: The Gulf of Mexico as a Measure of Isostasy, *Amer. Journ. of Sci.*, Ser. 3, Vol. 44, 1892, pp. 177–192, reference on pp. 189–191; see also *Bull. Geol. Soc. of America*, Vol. 3, 1892, p. 502.

base of the Tertiary in southern Louisiana now lies about twice as deep as the deepest waters in the Gulf. As in the case of all other known geosynclines, the sedimentation has occurred chiefly within a very short vertical range from sea level throughout the section.

Contest between Subsidence and Delta Growth

Mississippi River sediment on the one hand builds a delta into the Gulf of Mexico and on the other causes subsidence of a considerable portion of the coast. Each effect is most pronounced in the vicinity of the river's mouth. The points of debouching have shifted from time to time both eastward and westward along the coast of Louisiana and northward and southward along the Mississippi Valley, at times probably advancing well beyond the existing coast. The cumulative effect of deposition and concomitant subsidence since the Comanchean has been the origin and filling of the Gulf Coast Geosyncline together with a transverse structure, the northern part of which is usually called the Mississippi Embayment. Today's expression is that of the gulfward extension of a natural-levee complex flanked by the most notable bays, lakes, marshes, and swamps of the entire Gulf Coast region.

Each active discharge channel extends its own natural levees into the Gulf. Their growth is rapid.[8] When several of these channels function at the same time, as do the existing "passes" of the delta, the indentations between salient levees and between the outermost levees and the adjoining coast become bodies of slack water where sediment settles readily and filling goes on rapidly. Garden Island Bay, between South and South East passes, and West Bay, north of the west levee of South West Pass, have been filling very rapidly during the past few decades and serve as notable examples. Delta growth occurring thus rapidly obscures the effect of subsidence, but it takes place only near active distributaries. When a channel is abandoned, subsidence continues but deposition lags or ceases. Within comparatively recent times the active channels of the Mississippi discharged eastward from New Orleans, through what is now St. Bernard Parish. Natural levees along these channels in all probability extended as far as the Chandeleur Islands. But when this eastward discharge was abandoned in favor of the existing southerly river course, through Plaquemines Parish, the old eastern delta ceased growth. Subsidence continued. Bayou La Loutre, Bayou Terre aux Boeufs, Bayou Petre, and many other old distributaries of the St. Bernard Delta are now so

[8] Raymond Thomassy, in "Géologie pratique de la Louisiane," New Orleans and Paris, 1860, pp. 91–94, Pls. II, III, and VI, presents a critical discussion and copies of several old charts. The present writers will investigate, during the summer of 1935, current reports that the inner end of Eads's jetties, constructed in 1875, on South Pass, are now four miles inland and have subsided at the rate of one foot per 25 years.

submerged that the distal ends of their levees pass below sea level. The waters of Chandeleur Sound have invaded about one-half of the marshlands between the channels of this delta and have crossed old watercourses in many places, so that levees are now detached and stand as curious double islands separated from their landward continuations along remnant channels. Farther inland the submergence has reduced old prosperous plantations to marshes useful only to hunters, trappers, and fishermen.[9] Indian mounds and camp sites in the coastal marsh region tell the same story.[10]

Shifting Channels of the Mississippi

The habit of the Mississippi River of shifting its course widely is by no means confined to the discharge channels of its delta. Upstream it has traversed practically all parts of its flood plain. Its confining cliffs are typically meander scarred. Remnant channels are soon effaced and buried under the natural-levee complex of tributary and back-swamp streams, but they are not unknown. Larto Lake, some 30 miles east of Alexandria and more than 15 miles from the nearest point on the river, is an excellent example.[11] Bayou Teche, which flanks the bluffs west of the flood plain for nearly 40 miles, occupies the south end of an abandoned Mississippi River channel identifiable for at least 140 miles, between southern Avoyelles Parish and the lower Atchafalaya River.[12] It seems improbable that remnant channels still exhibiting the meander pattern of the Mississippi and preserving the typical sediments of its natural levees can be more than a few centuries old.

Although Pleistocene delta sediments are buried deeply on or near the Gulf shores, back of the coastal marsh zone remnants are preserved

[9] A. C. Trowbridge (Building of Mississippi Delta, *Bull. Amer. Assn. of Petroleum Geologists*, Vol. 14, 1930, pp. 867–901, reference on p. 877) cites facts and relates submergence chiefly to compaction in delta sediments. The present writers do not deny the importance of compaction; they feel certain, however, that the magnitude of compactional effects is wholly incommensurate with the amount of subsidence that has actually occurred.

[10] An excellent description of the cultural effects of submergence is given by E. A. Smith, L. C. Johnson, and D. W. Langdon: Report on the Geology of the Coastal Plain of Alabama, *Geol. Survey of Alabama Special Rept. No. 6*, 1894, pp. 45–47. For other examples see L. C. Johnson: The Nita Crevasse, *Bull. Geol. Soc. of America*, Vol. 2, 1891, pp. 20–25, reference on p. 23; and the report of H. C. Ripley, assistant engineer, in *Ann. Rept. Chief of Engineers . . . for the Year 1875*, Part 1, pp. 889–893, reference on p. 889. J. R. Czajkowski (Preliminary Report of Archeological Excavations in Orleans Parish, *Louisiana Conservation Rev.*, Vol. 4, 1934, pp. 12–18, reference on pp. 14 and 18) describes the finding of pottery beneath a natural and undisturbed layer of shells now 7 feet below sea level. Dr. F. B. Kniffen of Louisiana State University is now investigating pottery, bones, charcoal, and other evidences of a camp site recently discovered in dredgings in 12 feet of water 6 miles off the point next east of Mandeville, in Lake Pontchartrain. The culture represented appears to be relatively late in terms of lower Mississippi Valley chronology, and the nature of the materials apparently precludes the possibility of their having drifted into their present position.

[11] R. J. Russell: Larto Lake, An Old Mississippi River Channel, *Louisiana Conservation Rev.*, Vol. 3, 1933, pp. 18–21 and 46.

[12] Occupied more recently by Red River, which deposited a narrow strip of characteristic sediment within older, larger, and characteristic Mississippi River levees. See Howe and Moresi, *op. cit.*, pp. 65–71; and the same: Geology of Lafayette and St. Martin Parishes, *Louisiana Dept. of Conservation Geol. Bull. No. 3*, 1933, pp. 18–19, 23–25, and 31–42.

on both margins of the existing valley. These form surfaces at several different levels.[13] The higher surfaces are older and dip gulfward somewhat more steeply than the lower surfaces. No attempt to differentiate these various levels is indicated in Figure 2, which shows the distribution of a portion of the Pleistocene delta complex. The general apical region of the Pleistocene deltas lay 40 miles or more

FIG. 1—Location map of the Mississippi delta region.

north of Opelousas. Much of its northern part has been removed by erosion, but a large remnant is preserved west of the existing flood plain and extends inland to a point about 30 miles northwest of Opelousas.[14] On the east it is bounded by the escarpment facing the flood plain, on the west by an escarpment fronting an older upland extending southwestward past Lake Charles. To the south it passes under Recent accumulations of the coastal marshes. The drainage pattern of the approximately 28,600 square miles of delta remnant thus included is predominantly that of radial distributaries from the apex. Many of the channels are flanked by huge natural levees, not only out of all proportion to the streams now occupying them but spaced at the same distances as those of the existing Mississippi. Soil profiles are well differentiated and indicate a comparatively long interval of efficient seepage and oxidation.

Where the Pleistocene surface passes under marsh deposits to the south, its slope is about one foot to a mile. As this gradient is considerably steeper than that of the existing delta, it suggests regional

[13] The writers have identified at least three east of the valley, near Baton Rouge. The lowest has a maximum elevation of about 40 feet and extends southeastward toward Port Vincent. The intermediate surface, at about 60 feet, lies between Baton Rouge and the vicinity of the Baker Drainage Canal. The upper surface, which is far more dissected and has developed maturer soils, has maximum elevations of about 100 feet and extends northward to the vicinity of St. Francisville. The northern boundary of these Pleistocene deltaic surfaces extends eastward south of the towns of Jackson and Clinton and eventually bounds a Pleistocene Pearl River delta.

[14] Howe and Moresi, Geology of Lafayette and St. Martin Parishes, pp. 17–18 and Fig. 6.

tilt. The deltaic subsoils are recognizable in the coastal parishes when brought to the surface in canal dredgings and in boreholes. They are oxidized yellowish and contain lime and iron-manganese nodules such as could have originated only where there was adequate drainage, hence above sea level.[15] They now lie below it, and the depth of burial increases progressively toward the coast.

Origin of Cameron Marsh

Cameron Marsh occupies a coastal strip ranging from 20 to 30 miles in width in southwestern Louisiana. Without natural demarcation it passes eastward into Vermilion Marsh, these two names corresponding to those of parishes. Still farther east lie Vermilion, West and East Cote Blanche, and Atchafalaya bays, Atchafalaya flanking the active Mississippi delta on its west side.

The marsh deposits consist essentially of fine sediments more or less mixed with vegetational remains and their decomposition products. In places they include beds of the common brackish-water clam, *Rangia cuneata*. Borings indicate the presence of occasional layers of peat. All the marsh deposits have formed through reduction and, hence, stand in striking contrast with the oxidized subsoils of the delta remnant upon which they rest.

Cameron Marsh was evidently formed under conditions no longer in effect. The Gulf today, as the result both of subsidence and of erosion, is destroying rather than creating marshes in this vicinity.

Subsidence features are numerous. Toward the east, nearer the active Mississippi delta, submergence of the marsh has formed the large bays mentioned above. Their outlines suggest former existence as three or four separate lakes now united as the result of subsidence and said to be rapidly enlarging. Within the marsh are innumerable lakes, the largest of which are White, Collicon, Grand, Calcasieu, and Sabine, in order from east to west. For the most part these lie toward the north, rather than near the Gulf, apparently for the reason that the inland side of the marsh is older and has been subsiding longer.

The history of the coastal marsh lakes and watercourses is a story of increasing salinity. When their shores were occupied by mound-building Indians, there was evidently enough fresh water to support a considerable population. The shell mounds are numerous, and many of them are large.[16] In the debris of mounds and camp sites

[15] W. H. Heileman and Louis Mesmer: Soil Survey of the Lake Charles Area, Louisiana, *U. S. Dept. of Agric., Field Operations of the Bur. of Soils, 1901 (3rd Rept.)*, pp. 621–647, reference on p. 626. This contains several accurate observations, but many of the interpretations are not those of modern pedology.

[16] The Alligator, near the southeast corner of Grand Lake, is the only known effigy shell mound of the Gulf Coast region. Between one-third and one-half of the original structure has been washed away by shore erosion, but 200 yards remain unattacked and include a portion of the alligator's body and two limbs. Boreholes show subsidence of the base of the mound from an unknown original elevation, possibly six feet or more, to a depth of at least six feet below sea level. Dr. F. B. Kniffen is studying the pottery found mixed with the shells and, in time, will give a full report of this discovery.

near the north side of the marshes are shells of the fresh-water clam, *Unio*. Surrounding waters are now too saline for the growth of this genus, and it is found only ten miles or more upstream. Similarly, farther south the brackish-water *Rangia*[17] forms the bulk of the mounds, even though salinity prevents its growth near by today. The bases of most of these mounds now lie below sea level, and entire

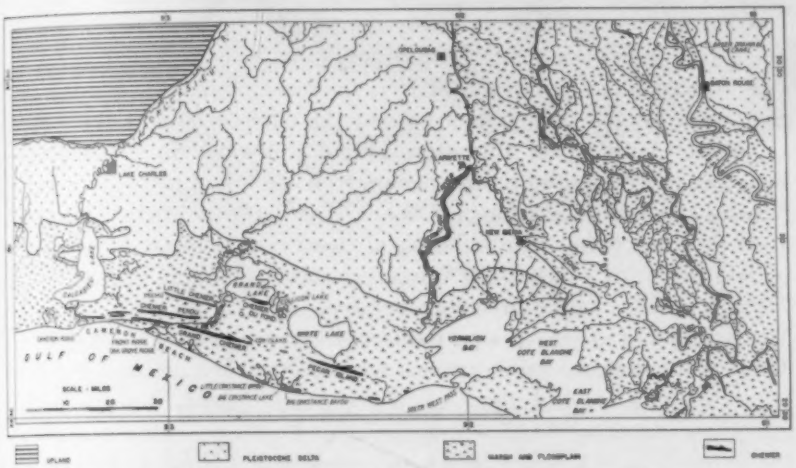

FIG. 2—A part of the delta complex of the Mississippi showing the cheniers.

mounds are known to have sunk below marsh level. Marsh deposits have thickened during the period of subsidence, so that the flanks, and even the tops, of mounds are covered. In recent years, however, as vertical marsh growth has not kept pace with subsidence, a number of lakes have formed and are being enlarged at a surprising rate. It seems evident that if present conditions continue an elongate sound will form westward from Vermilion Bay, which would be the western counterpart of Mississippi Sound and the lakes west to Maurepas, east of the Mississippi delta. Grand Lake, though more than 30 miles up the Mermentau River from the Gulf, is now too saline for the free growth of *Rangia;* the wake of a boat on the lake gleams at night from the presence of phosphorescent organisms, and propellers are often fouled in *Ruppia maritima*, a brackish-water grass more tolerant of salt than of fresh-water habitat.

In order to account for the sedimentation that originally built Cameron Marsh in the face of regional subsidence, we must turn to a factor clearly not in operation at present. That this was a more westerly discharge of the Mississippi River seems certain. Recent distributary courses are plainly evident as far west as Vermilion River (Fig. 2), a stream that cuts through Pleistocene delta deposits and

[17] Smith, Johnson, and Langdon, *op. cit.*, describe exactly the same condition in the marshes of Mississippi and Alabama.

enters Vermilion Bay.[18] It has not been long since Bayou Teche was the main river channel. After abandonment by the Mississippi it carried a considerable sedimentary burden while functioning as the outlet of Red River. With the exception of the Red River complication, a similar history appears to hold for Bayou Lafourche. Other western outlets of the Mississippi will probably be found when further investigation is carried out in the swampy flood plain and marsh belt west of the present channel. Recently issued quadrangles of the U. S. Geological Survey indicate natural levees in Vermilion Parish of such size and meander pattern that it is only reasonable to suppose that they were formed by a former Mississippi channel.[19]

Actual building of Cameron Marsh gulfward on the subsiding Pleistocene Mississippi delta appears to have taken place only during periods of westerly discharge. When the discharge turned eastward, as is the case today, the building of delta and flanking marshes also turned eastward and left the Cameron coast as a shore line in retreat. Though it did not take any great length of time, the growth of Cameron Marsh did not occur as one uninterrupted episode of delta history. There were times of rapid growth when subsidence was overbalanced by sedimentation and the Gulf shore advanced rapidly southward, as it does today below New Orleans, and there were other times when the shifting of discharge channels temporarily halted sedimentation and allowed subsidence and wave erosion to drive the shore inland, as is happening today not only in Cameron Marsh but everywhere else along the Louisiana coast, except only in the immediate vicinities of discharge channels.

Cameron Beach

Cameron Beach is a continuous sandy ridge along the shore of Cameron Marsh, broken only by the outlets of Mermentau and Calcasieu rivers and by a few bayous connecting directly with the Gulf. Across these stream channels it is represented by shallow, sandy bars. On the beach proper the depth of sand is ordinarily somewhat less than six feet and its maximum width about 100 yards. It lies as a veneer upon marsh sediments. In driving the shore inland wave erosion is attacking these marsh deposits so that the shore zone is muddy and a low sea cliff, rarely more than two feet high, separates muddy shore below from sandy beach above. Marine shells are abundant in the beach sand and may be found in irregular patches on the shore muds, and, occasionally, in local masses of reworked mud

[18] Howe and Moresi, Geology of Iberia Parish, pp. 67–68; W. W. Clendenin: A Preliminary Report upon the Florida Parishes of East Louisiana and the Bluff, Prairie and Hill Lands of Southwest Louisiana, *Geol. and Agric. [of Louisiana], Part 3*, Louisiana State Exper. Sta., Baton Rouge, 1896, p. 199; D. C. Barton: The Iberian Structural Axis, *Journ. of Geol.*, Vol. 41, 1933, pp. 225–242, reference on pp. 235–236.

[19] See, for example, Schooner Bayou, N.E., S.E., and S.W. sheets.

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Cameron Beach, about two miles east of Calcasieu River, showing sand overlying marsh mud of the shore zone.

FIG. 4—Inner side of Cameron Beach, showing the advance of sand across the marsh.

FIG. 5—Termination of Little Chenier at Mermentau River.

on the shore. Air-breathing snail shells and brackish-water clamshells are present in the unattacked marsh sediments. The general character of the beach is shown in Figure 3 and its inland boundary in Figure 4, which shows beach sand marching inland over marsh surface. It is apparent that the beach is essentially a shore feature and that it is advancing inland at the same rate that wave erosion is attacking the marsh. It forms a barrier that impounds the normal discharge of waters from the marsh so effectively that in 30 miles, from the mouth of Mermentau River eastward to the boundary of Vermilion Parish, there are some twenty or more lakes, some more than two miles in length, just inside the beach. Only four bayous cut through the beach in this distance.[20] Many stories are told by residents of Cameron Marsh of trapping and hunting around lakes no longer existent because of the advancing Gulf. Cattle are driven along the beach for the whole 80 miles between South West Pass, of Vermilion Bay, and the Sabine River, so continuous, firm, and high is the sandy ridge.

The sandiness of Cameron Beach indicates an effective sorting ability of wave erosion and deposition. The coast is subsiding; the shore is in very rapid retreat. The material being eroded is chiefly muddy marsh deposit, fine silt, clay silt, and clay. Yet little of this fine material is cast upon the shore. The beach consists of clean, almost pure quartz sand and fragments of marine shells. Fine sediment is carried out into the Gulf very effectively; the coarsest material available to the waves is borne inland. It seems reasonable to suppose that in the course of a long march inland the beach will accumulate more and more of these coarse materials and grow in volume.

Origin of Cheniers

The similarities between Cameron Beach and the cheniers to the north in the marsh are at once apparent. Both are elongate, comparatively narrow strips of sand overlying marsh deposits.[21] The beach follows the shore precisely. Chenier trends approximate that of the coast, agreement being closer in ridges nearest the Gulf. The significance of these similarities is strengthened by gradational changes within the chenier series itself.

Grand Chenier (Fig. 2) is the freshest and most striking major ridge today. It extends from Mermentau River about S 80° E for

[20] The inland retreat of the shore is estimated locally to average about six feet a year during normal times and may be hundreds of feet during a hurricane. The U. S. Geological Survey Constance Bayou S.E. quadrangle surveyed in 1932 shows an elbow of Big Constance Bayou about 1200 feet inland. We have been informed that this elbow was reached by the Gulf during the hurricane of June, 1934, and the lake will probably be part of the Gulf by the time this paper reaches press.

[21] A borehole through Grand Chenier, starting on its seaward edge at an elevation of 2 feet, showed oxidized sandy materials and shells freshly preserved down to 7.5 feet and reduced bluish and greenish sands and silts down to 10 feet, where a layer of vegetational remains was encountered, below which were clay and fine silt to a depth of 19.7 feet, the bottom of the hole. The vegetational layer was apparently the surface of the marsh at the time of the advance of the beach-building sand.

nearly 15 miles to Cow Island,[22] where it passes down to about marsh level. It continues eastward as Long and Pecan islands, the latter having about the same dimensions as Grand Chenier itself. To the west it continues as Oak Grove and Front ridges. The total length of the interrupted chenier is nearly 70 miles. The width varies but ordinarily is less than 400 yards, except where local prongs extend inland across the marsh. Maximum elevations are about 10 feet. The soils are immature and sandy, with shells in evidence nearly everywhere. Subsoils are scarcely differentiated and contain many lenses of fragmental marine shells, unaltered and unleached.

Not quite so fresh as Grand Chenier is Cameron Ridge, which extends eastward from Calcasieu Pass for about eight miles. Elevations are, on the average, slightly less than those of Grand Chenier. Shells are notably less conspicuous in the soils, and darker colors predominate. Several small cheniers continue to the east, just behind Front Ridge, and have similar characteristics.

Chenier Perdu lies from one to three miles behind Grand Chenier and may be identified for about 18 miles, from the settlement of Creole east to the Mermentau. Considerable portions of this ridge lie at marsh level, so that local swells form "islands" marked by small clumps of trees rising abruptly above seas of grass and sedge. Soils are much darker than those of Cameron Ridge, and shell fragments are not particularly in evidence.

Little Chenier, from four to six miles north of Grand Chenier, extends from the settlement of Premo eastward for about 12 miles to the Mermentau. Maximum elevations reach about six feet, but long portions of the ridge lie below marsh level. Near the Mermentau it supports a luxuriant forest and shows a very distinct soil-subsoil differentiation, a stage of maturity far beyond that of any of the ridges farther south. Whereas the cheniers to the south are rather densely populated, the amount of dry land on Little Chenier is so small that houses are typically scattered at wide intervals.

Chenier du Fond lies along the south side of Grand Lake, about eight miles north of Grand Chenier. It was formerly known by a more appropriate name, de Faux, for it is actually a false chenier today. Most of the original ridge was located in what is now lake bed and appears as a belt of hard, sandy bottom, covered by less than three feet of water. Farther offshore, at the north edge of the chenier, the bottom deepens abruptly to about six feet and is composed of soft mud. The shore line today approximates the south border of the chenier, but at the southeast corner of Grand Lake part of the sandy ridge is preserved and stands slightly above marsh level. Boreholes

[22] Considered the end of Grand Chenier locally. This has been incorrectly designated as Tiger Island on most official maps, including the advance proofs of the recent U. S. Geological Survey quadrangles. Tiger Island is actually the next high point west of Cow Island.

here show oxidized sandy materials down to 7 feet below low water level. Just to the south they encounter an unbroken section of muds and muck. Two dwellings are the only habitations on this chenier, and plowed land amounts to less than ten acres. The reason that it is called a chenier locally appears to lie chiefly in the fact that the waves of the lake have formed a sandy beach out of the eroded chenier materials and these support a growth of trees similar to that on the ridges to the south. The old name, Chenier de Faux, was possibly applied in full recognition of this condition.

This list includes the principal members of the chenier series of southwestern Louisiana. A few other small cheniers are known to exist, and still others are suggested by various maps but have not been visited by the writers. The name "chenier" has also been applied to a few "islands" and ridges of an origin unlike that of the features here described. These are ordinarily remnants of natural levees along both active and abandoned streams. In general they differ from true cheniers in shape and orientation and also in that they consist essentially of silt rather than of sand. Where marsh fires have burned out the peaty accumulations in their flanking channels, depressions, sometimes called blind bayous, run parallel to them.

The arrangement of the cheniers is clearly that of a sequence from youngest, nearest the coast, to oldest, farthest inland. Grand Chenier is the widest, most continuous, and highest, has the least altered soils and the most luxuriant natural vegetation, and supports the densest population. Progressively inland these features are more and more modified as the result of greater age and submergence, the chenier bordering Grand Lake being so changed that it has been called "false." To complete the entire sequence, we should add the youngest of all, Cameron Beach, a chenier in the making.

Just as Cameron Beach is clearly the result of wave action during a period of coastal submergence and shore retreat, each chenier appears to mark such a period and thus a halting stage in the growth of Cameron Marsh. Halting stages in the sedimentary record of southwestern Louisiana are apparently associated with periods of easterly Mississippi sedimentation. If such periods persist the coastal beach grows proportionately in size. The renewal of westerly discharge of the Mississippi conditions marsh growth and shore advance beyond the beach so that it is isolated from the shore and left surrounded by marsh, thus becoming a chenier. Each chenier thus marks a period of coastal retreat between two periods of advance. On the whole the coast has been advancing more than retreating recently, and so a series of cheniers remain stranded in the marsh, those first formed, inland, to the north, and those most recent, toward the coast. Should the Mississippi abandon its present channel and again turn westward, its main channel would undoubtedly follow the course of the Atchafa-

laya. This would probably be the case today had not extraordinary means been employed to prevent diversion. The growing volume and depth of the Atchafalaya and the rapidity with which it is filling the lakes in the lower part of its course suggest that the time for renewal of westerly sedimentation is not far off; and when this occurs the sediments will again advance the shore of the southwestern marshes, and Cameron Beach will become a chenier.

The continuance of submergence since the cheniers were formed has not only lowered the older, northern, ridges more than the younger but has also created inland lakes that are becoming increasingly more saline. Much of the original sea marsh has become covered by inland-marsh deposits. The sequence of events represented is not one of alternate elevation and depression but rather of continued subsidence together with alternations between deposition and wave erosion conditioned by shiftings in the direction of Mississippi River discharge. The underlying causes of the entire Recent history of southwestern Louisiana are explicable only in terms of delta sedimentation. The prevailing easterly tilt of the cheniers and marshes and the greater abundance of the sandy ridges west in Cameron Parish, rather than east in Vermilion, confirm observations of delta downwarp advanced on the basis of terrace tilts east of the river.[23] The time involved in building the marsh and its cheniers is insignificant as compared with that over which the Mississippi River has been dominating the geologic history of the north shore of the Gulf of Mexico. The Mississippi may be looked upon not only as "Father of Waters" but as "Father of Gulf Coast Geology and Geomorphology" as well.

[23] Frank Leverett: The Pensacola Terrace and Associated Beaches and Bars in Florida, *Florida State Geol. Survey Bull. No. 7*, 1931, pp. 26–29.

BAYOU MANCHAC: A PHYSIOGRAPHIC INTERPRETATION*

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THE typical distributary of the lower Mississippi is a shallow, slow-flowing stream, meandering through a low, featureless plain of recent alluvium in a channel bordered by marked natural levees. Such are Bayou Plaquemine and Bayou Lafourche, two of the better known distributaries. A cursory look at the map classes Bayou Manchac as a similar feature, but a close examination of the stream itself reveals several striking differences. Leaving the flood plain of the Mississippi, its channel cuts through a well defined terrace, joins the Amite River, and reënters recent deltaic deposits. A portion of its bed is maintained at depths below sea level, and the direction of its flow may be reversed by backwater from the Amite. In marked contrast with every other stream in the vicinity, the Manchac is flanked by a small terrace of its own through a short part of its course.

Leaving the Mississippi at a point about nine miles below Baton Rouge, the Manchac flows slightly north of east some nineteen miles to its junction with the Amite. With the Amite River, Lake Maurepas, and Lake Pontchartrain, Bayou Manchac in colonial days offered a route from the upper Mississippi to the Gulf, alternative to the lower river and New Orleans. Small boats continued to ply this route until 1814, when Andrew Jackson, for strategic purposes, constructed an earthwork dam to sever water connections between the Manchac and the Mississippi. Jackson's work was made permanent by further dam building in 1824 and by the subsequent building of levees. Within the last five years there has been an unsuccessful movement to restore the Manchac route and make it navigable for small steamers.

The channel of Bayou Manchac falls into three well defined sections: from the Mississippi to mile 10 (Fig. 1); from mile 10 to mile 8; from mile 8 to the junction with the Amite. The first section is essentially a built channel. It lies upon the outward slope of the Mississippi flood plain, into which it is but slightly incised. The shallow channel is confined by natural levees, which from a height of four feet on the banks of the stream slope down to ground level in a distance of 400 feet.

Even before it was dammed at the point where it left the Mississippi Bayou Manchac was an intermittent stream in its first five

*The writer gratefully acknowledges his indebtedness to his colleagues, Dr. H. V. Howe and Dr. R. J. Russell; to the former for pointing out the problem, to both for constructive criticism and productive suggestions. He also acknowledges the valued assistance of the late Dr. A. H. Meyer, agronomist, and that of Professor E. B. Doran.

or six miles. This shallow, steeply sloping section of the channel carried water only when the Mississippi was high enough to flow through the notch in its natural levee that formed the outlet to the Manchac. At low water the dry bed of the Manchac lay some fifteen feet above the surface of the Mississippi; at high water the upper Manchac was a rushing torrent, flooding its levees to a minimum depth of one foot.[1]

In contrast with the first, the second section of Bayou Manchac, from mile 10 to mile 8, is a deeply cut channel, with narrow flood plain and insignificant levees. Flanking the stream and standing at an elevation of about twenty feet is a small but well defined terrace, the remnant of the flood plain of an older Manchac. This may be called Manchac terrace to distinguish it from the higher terrace into which it is cut. At the east end of the two-mile section Manchac terrace merges imperceptibly into the flood plain of the lower Manchac. An examination of other streams in the vicinity shows terrace development to be peculiar to this small section of the Manchac. The higher terrace, through which the east half of Bayou Manchac has cut its course, may, in the absence of definite knowledge about its correlation or genesis, be designated by the term "Upland." It meets the Mississippi flood plain in a well defined erosional escarpment, ranging from ten to twenty-five feet in height. The surface has an average elevation of about thirty feet and thus lies well above possible incursions of Mississippi floodwaters. The terrace is composed of a uniform silt, easily distinguishable from the sandier flood-plain deposits of the recent Mississippi.

A profile across this middle section of the Manchac (No. 2) shows the well rounded reverse curve by which Upland terrace merges into Manchac terrace, the narrow trenchlike channel, and the slight width of the flood plain. The Manchac terrace is purely a dissection feature of the Upland terrace; the narrow flood plain, however, shows a thin veneer of recent Mississippi sediment.

The third and easternmost section of Bayou Manchac is characterized by a narrow, deep channel and a relatively broad flood plain (No. 3). In contrast with the preceding section, there is no suggestion of a stream terrace, but the natural levees show moderate development.

Clues to the Genesis of Bayou Manchac

Keys to the interpretation of the Manchac's genetic history must be looked for not only in the nature of the bayou itself but also

[1] Most of the historical information was obtained from the following: J. K. Hezlep: The Manchac Project, *DeBow's Review*, July, 1868, pp. 640–643; Philip Pittman: The Present State of the European Settlements on the Mississippi, edited by F. H. Hodder, Cleveland, 1906; William Bartram: Travels Through North and South Carolina, Georgia, East and West Florida . . . , London, 1792; and William Darby: A Geographical Description of the State of Louisiana, 2nd edit., New York, 1817.

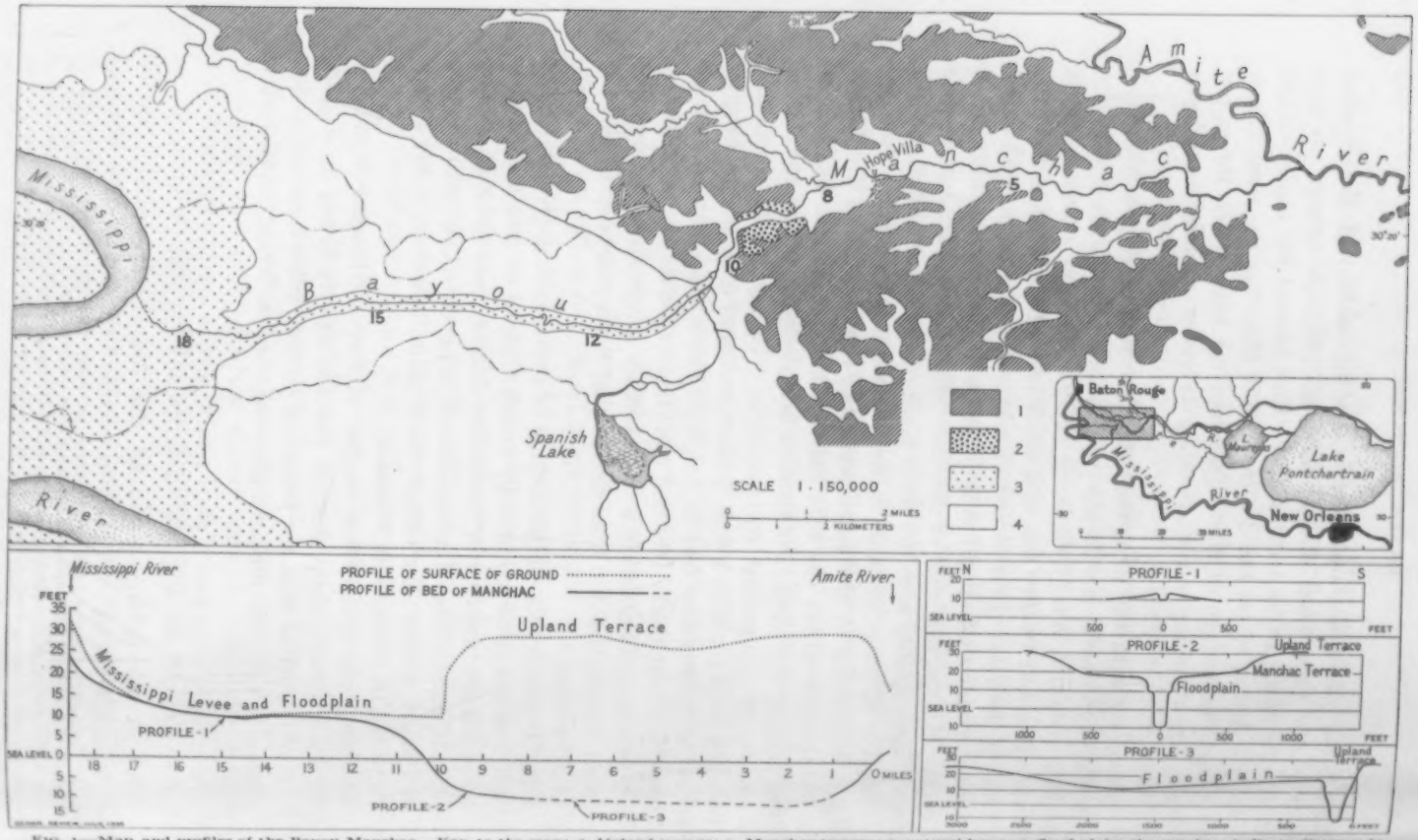

Fig. 1.—Map and profiles of the Bayou Manchac. Key to the map: 1, Upland terrace; 2, Manchac terrace; 3, natural levee; 4, flood plain; the numbers indicate distance in miles along the Manchac from its junction with the Amite. Of the terraces on which a 5 ft mile, 3.5 ft mile, 2 ft mile, 1 foot/mile gradient is measured, only the 5 ft mile terrace is shown on the map.

in three physiographic features of the surrounding area: the character of the normal dissection of the Upland terrace; the peculiar dissection of the escarpment of the Upland terrace; and the hydrographic features associated with Spanish Lake.

The Upland terrace is submaturely dissected by a number of insignificant streams having their origin in local precipitation and by the larger Amite River, which rises in the hills of Mississippi, some miles to the north. The flood plains of the local streams are fairly broad and merge into the surface of the Upland terrace through well rounded solifluction slopes. Many of the minor tributaries are properly dales, broad, gently rounded, and with barely perceptible channels. As a dissection feature of the Upland terrace, the Manchac terrace shows a similar profile. Except for the two-mile section flanking the Manchac, the absence of stream terraces is strikingly notable.

In sharp contrast with this are the forms of the short streams that dissect the escarpment joining the Upland terrace and the Mississippi flood plain. The valleys are marked by the angularity with which their steep walls meet the terrace surface and by their broad, flat bottoms. The valley floors are marshy and the streams that occupy them sluggish and intermittent. Above their flat bottoms the valley profiles are suggestive of the gullies that dissect the high Mississippi bluffs north of Baton Rouge. Their flat, marshy floors are indicative of a rise in local base level, accompanied or caused by deposition of Mississippi sediment along the margin of its flood plain. In other words, these minor dissection features are "drowned" gullies—"drowned," that is, with alluvial deposits from the Mississippi. From the point where Bayou Manchac enters the Upland terrace from the Mississippi flood plain it runs for a mile through the "drowned" valley of a former westward-flowing gully.

The third significant clue is found in the peculiar drainage features associated with Spanish Lake. This lake occupies a shallow basin that serves as a reservoir when the flow of the Manchac is reversed by high water in the Amite. During late summer the lake is nearly dry. But what is more pertinent is the fact that Spanish Lake drains northward through Bayou Manchac, rather than southward along the edge of the Upland terrace, as it normally should. This northerly direction of drainage is caused by a low ridge that connects the Upland terrace with the high levee of the Mississippi to the south of Spanish Lake.

The Genetic History of Bayou Manchac

On the basis of this evidence the physiographic history of the Bayou Manchac may be interpreted thus. After the appearance of the Upland terrace as such, dissection of its surface proceeded slowly by means of small streams occupying relatively broad, gently rounded

valleys. The ancestral Manchac was an insignificant tributary to Ward Creek, the north-bank tributary to the Manchac at mile 8, its head reaching westward to the vicinity of mile 9. With a much higher escarpment than at present, dissection proceeded rapidly on the outward margin of the Upland terrace. Short but deeply cut gullies poured occasional torrents of mud and water out on the Mississippi flood plain. One such gully moved headward toward the ancestral Manchac and probably slightly notched the divide separating them. Conditions must have remained thus until after the gullies were drowned by the encroachment of Mississippi sediments.

The next significant event came as a result of the impounding of floodwaters of the Mississippi between its natural levee and the Upland terrace. The evidence of impounding is found in Spanish Lake. After the ponded waters had reached a height of about twenty feet they found a partial outlet through the notch cut into the upper valley of the Manchac. The manner of their exit must have been similar to that observed in recent crevasses—they quickly cut a deep channel, leaving the remnants of old Manchac valley floor as a terrace. When they reached the junction with Ward Creek, they encountered a flood plain broad enough to accommodate the surplus waters.

Last to appear was the built section of the channel, lying between the Upland terrace and the left bank of the Mississippi. Leaving the Mississippi through the notch on the outside curve of its levee, subsequent overflow waters were given direction and passage through the newly created break to the Manchac, and this was enough to induce the building of levees with a subsequent slight scouring of a channel.[2]

In its broad outlines this is the genetic history of Bayou Manchac. Deprived of its function as a distributary of the Mississippi, through damming and building of levees, the Manchac drainage system has suffered a number of modifications. The shallow, steeply sloping upper section of the channel is dry during most of the year, occasionally carrying a little seepage water from the Mississippi. From the escarpment of the Upland terrace eastward the stream is perennial and maintains its below-sea-level depth. A part of its water is derived from local precipitation; the remainder is provided by backwater from the Amite. With heavy local precipitation or falling water in the Amite the Manchac shows a perceptible current setting eastward. With the Amite in flood the Manchac flows westward, Spanish Lake acting as a reservoir to hold the influx of water. To the scouring action of the Manchac's ebb and flow may be attributed the maintenance of its great depth; the genesis of the deep channel was an event of its earlier history.

[2] A comparable phenomenon was actually observed in the Colorado delta. See the writer's "Lower California Studies: IV, The Natural Landscape of the Colorado Delta," *Univ. of California Publs. in Geogr.*, Vol. 5, No. 4, 1932, p. 169.

THE BUSINESS OF RECREATION

Robert M. Brown

IT has been estimated that 16,000,000 American tourists visited Canada in 1929, and even during the depression year 1933 no fewer than 11,000,000 Americans crossed the Canadian border. The expenditures of these tourists in 1929 amounted to $295,585,000, or more than a third of the total value of United States exports to Canada in that year. During the same year American tourists spent $301,142,000 on travel in Europe and the Levant,[1] or about 28 per cent of the value of United States exports to Europe. The expenditures of American tourists on foreign travel in 1929 amounted to $839,000,000, or more than the net income of all New England corporations then paying federal income tax. These figures may give some idea of the magnitude and economic significance of the American tourist movement in so far as it involves foreign travel. Of yet greater importance is the domestic movement with which this paper is concerned. It is estimated that nearly four billion dollars was spent in motor camping and vacation motor travel in the United States in 1929. The State Hotel Commission estimates that 1,750,000 tourists spent $625,000,000 in Florida during the past season (1934–1935). In Maine the tourist "crop" ranks second among the state's industries; it is placed third in Michigan and fourth in Minnesota.

Terminology

The economic aspects of recreation, although generally accepted, have not lent themselves readily to tabular and graphic representation, and largely for that reason the subject has received but scant notice from students of the social sciences and from geographers.[2] The language of the tourist business, furthermore, is highly generalized, and a common vocabulary that can be used effectively is wanting. There is no satisfactory term for the business in all its aspects. "Recreation" is admittedly broad, but, on the other hand, "tourism" neglects in its implication the great host of vacationists who are summer residents. Ogilvie in his book on "The Tourist Movement"[3] at the outset faces this difficulty of terms, and the lack of them he calls "one of the curiosities of language." Any classification of the busi-

[1] H. M. Bratter: The Promotion of Tourist Travel by Foreign Countries, *U. S. Bur. of Foreign and Domestic Commerce Trade Promotion Ser. No. 113*, 1931, p. 2.

[2] See also the note "Some Geographical Aspects of Tourism" elsewhere in this number of the *Geographical Review*.

[3] F. W. Ogilvie: The Tourist Movement: An Economic Study, London, 1933. The first part of this useful book is devoted to the general economics of the subject, the second and third parts respectively to the tourist movement of the United Kingdom and that of eleven foreign countries (including the United States and Canada) under the headings of external movement, length of stay, and expenditure.

ness of recreation will not have behind it usage or the test of trial; but for the purpose of narrowing the field the following somewhat obvious groupings are made: (1) The advantages for recreation offered by town, county, state, or nation primarily to local visitors, such as playgrounds, parks, and other special resources; (2) The advantages offered to a holiday trade, particularly the "week-ender"; these may be local, and they attract visitors whose homes are within a day's drive; (3) The advantages offered to the vacationist and the tourist.

This paper has to do mainly with the last group. The Century Dictionary defines a tourist as one who travels for pleasure, visiting a number of places to see the scenery, sights, etc. Ogilvie classes tourists according to two characteristics: first, that they are away from home for any period not exceeding one year; and second, that they spend money in the places they visit without earning it there. If the period of stay exceeds a year, the person is a migrant; if he spends money earned where he is staying, he is neither tourist nor migrant. One may adopt an English classification that is awkward but general and call him a business visitor. Again, tourism implies traveling (the Century Dictionary definition) rather than staying, and vacationing implies either staying or traveling or both; and thus our language fails us in this particular. A man who spends his summer as a guest in a White Mountain hotel is a tourist, according to Ogilvie's classification; a student from one of our colleges who works as a waiter in the hotel is not; and yet the student is a definite factor in the tourist business. The economic significance of the tourist movement, Ogilvie points out, covers the items of services and goods, and services are of greater importance; for "while tourists are not to be despised as consumers of goods . . . it is mainly as consumers of services that they are to be considered, and especially of two large groups,—hotel services and transport services."

One reason why so little interpretative work has been done in this country on the economics, sociology, and geography of tourism is that it was largely engaged in only by a few relatively rich people until the coming of the automobile. The habit of compiling statistics on tourism did not develop. The Bureau of the Census gathers no such data, nor does the *Statistical Abstract of the United States* give any figures that bear directly on the subject. Because of the lack of comprehensive statistics few facts or comparisons of nation-wide range could be arrived at. Recently, however, individual states have come to understand the importance of tourism within their borders, and national land planning recognizes the recreational use of land. Thus "Recreational Land" is a category in the National Resources Board's report.[4] At the same time it is being realized that recreational areas

[4] See W. L. G. Joerg: Geography and National Land Planning, *Geogr. Rev.*, Vol. 25, 1935, pp. 177–208.

need conservational care. The Forest Service of the U. S. Department of Agriculture in "A National Plan for American Forestry"[5] recommends the withdrawal of 45 million acres of forest land for recreational uses and submits a program for its utilization. The activities of the American Shore and Beach Preservation Association are directed to the conservation of an important recreational asset.

The distribution and climate of mountain, forest, lake, and seabeach on the one hand and the distribution of population on the other are prime elements determining recreational land use. "It is a happy circumstance that 45 percent of the total population, or 55 million persons, live within 55 miles of the sea coast or the Great Lakes. Unfortunately, the great resources of the mountains, particularly in the West, have no such fortunate relationship to location of population."[6] These distributions are shown on a map of the "Geography of Recreation" prepared by the Bureau of Agricultural Economics in which green overprinting marks the broad limits of the potential recreational areas, summer and winter.[7]

Analysis of the Tourist Movement

Among recreational areas New England holds a preëminent place, not only by reason of scenic beauty and accessibility but by conscious effort at development of the industry, and nowhere has its development wrought more marked change. Chidester concludes his survey of recreation as a land use in New England with the observation that "the studies here presented clearly point to the conclusion that many towns in New England are practically dependent for their very existence upon the use of their land for recreational purposes. With land becoming submarginal for agricultural or industrial uses, these hamlets would have declined to a state of stagnation if the acreage could not have been turned to recreation. Economically and socially the resulting change is an important force in the life of New England today."[8]

Information on the industry, however, even in New England, remains scrappy. A resort map of the United States published in 1930[9] locates 1309 resorts, 479 classed as of primary, and 830 as of secondary, importance, of which 330 are in New England, 245 in New York, and 123 in Minnesota.

[5] *73d Congr., 1st Sess., Senate Doc. No. 12*, 2 vols., Washington, 1933. See also H. S. Graves: A National Plan for American Forestry, *Geogr. Rev.*, Vol. 24, 1934, pp. 129–133.

[6] National Resources Board: A Report on National Planning and Public Works in Relation to Natural Resources . . . , December 1, 1934, Washington, 1934, p. 145.

[7] *Ibid.*, facing p. 144.

[8] L. W. Chidester: The Importance of Recreation as a Land Use in New England, *Journ. of Land & Public Utility Economics*, Vol. 10, 1934, pp. 202–209; reference on p. 209.

[9] The Resort Markets of the United States, Marketing Division, International Magazine Company, Inc., New York, 1930. The map accompanies a list giving the distance of each resort from the main trading center, the population, number of retail outlets, drugstores, banks, etc.

Beginnings are being made in the study of the statistical and other aspects of the tourist movement, and certain measures and estimates that have been applied of late to the investigation of its economic aspects will now be noted.

Counts of Tourists at Political Boundary Lines

Certain states have undertaken the count of the tourists entering their domains. A recent estimate of the Maine Publicity Bureau is based on a federal highway survey made at the state's border gateways in 1924, which yielded 443,292 pleasure cars for 123 days from July 1 to October 31. By multiplying this by 3⅛ (the national average number of persons to a car according to the American Automobile Association) a total of 1,385,287 persons is obtained, going and coming, one-half of whom, or about 700,000, entered the state. If an estimated number of 300,000 for the off-season months and for railroad and steamship travel is added, a total of 1,000,000 visitors during 1924 is reached. An increase of 5 per cent for each subsequent year gives 1,250,000 visitors for 1929.

Colorado reports 323,578 automobiles from other states in 1931. This figure was obtained by an actual count for six months of cars entering Denver when the state-wide count was not operative, by an actual count for five months at the nine gateways to the state, and by an estimate for one month—December—when no count was made. Reckoning 3.06 passengers to a car, the number of people who visited Denver by private automobile was 990,148. The figure 3.06 was obtained by a count of all out-of-state cars entering and leaving Denver between August 22 and September 2. An estimated arrival by railroads of 400,000 brings the total number of visitors during 1931 up to 1,390,000.

Much more precise estimates of tourist travel may be made at international frontiers, since such frontiers are also tariff walls. More tourist traffic passes over, and tourists carry more money over, the United States-Canadian border than over any other international boundary.[10] We have seen that $296,000,000 was spent by United States tourists in Canada during the peak year 1929. In the same year Canadian tourists spent $94,000,000 in the United States. This balance of trade in invisible exports and imports, although unfavorable to the United States and somewhat trying to New England publicity bureaus, is pleasing to Canada. The fact, however, that the average expenditure of the foreign visitor in Canada is only about $4.00 a year for merchandise and the total expenditure only $15.00 a year as compared with a corresponding total expenditure of $750 a year by the American tourist in France has incited Canadian manufacturers to renewed efforts to attract the tourist's dollars. Since 1929 the ex-

penditures of American tourists in Canada have consistently dropped. In 1933 they were only $101,000,000, and Canadian expenditures in the United States had fallen to $35,000,000. During 1933, 2,233,418 cars entered Canada on 24-hour permits, 863,136 on 60-day permits, and 333 on 6-month permits—a total of 3,096,887 cars. By using the

TABLE I

VISITORS TO VARIOUS NATIONAL PARKS*

	1930	1931
Rocky Mountain, Col.	255,874	265,663
Mesa Verde, Col.	16,656	18,003
Carlsbad Caverns, N. Mex.	90,104	81,275
Glacier, Mont.	73,776	63,497
Grand Canyon, Ariz.	172,763	156,964
Yellowstone, Wyo.	227,901	221,248
Yosemite, Calif.	458,566	461,855

*Annual Report, National Park Service.

TABLE II

VISITORS TO NEW HAMPSHIRE*

	Based on Road Toll Tax	To White Mountain National Forests	At Information Booths
1928	1,162,000	2,414,000	81,668
1929	1,424,000	2,046,000	81,179
1930	1,530,000	1,928,000	105,857
1931	1,630,000	1,563,000	97,033
1932	1,408,000	.....	.....

*Biennial Report III, State Development Commission, Concord, N. H., 1932.

normal average of 3⅛ persons to a car and adding the number entering Canada by railroad and steamship lines it is conservatively estimated that about 11,000,000 persons from the United States visited Canada in 1933.

ESTIMATES BASED ON HOTEL AND ADMISSION RECORDS

Enumeration of the distribution of tourists among hotels, tourist homes, camps, and the like within a given area is also difficult. By means of questionnaires sent out annually from 1923 to 1930 the Maine Publicity Bureau obtained from a limited number of tourists (less than 4000) their choices of lodging places and lengths of stay. Thus for 1930 the percentage distribution of tourists and the total number of days' stay were: hotels, 35 per cent, 13,287 days; adult camps, 13 per cent, 7644 days; farms, 4 per cent, 2329 days; housekeeping cottages, 13 per cent, 12,600 days; motor camps or tents, 19 per cent, 5490 days; and tourist homes, 16 per cent, 2441 days.

It is easier to obtain figures for admissions to public places, since attendants are generally stationed at the entrances, and even if an admission fee is not charged a count of patronage is ordinarily kept. The figures for the national parks (Table I) are based on counts for the summer months and estimates for the full years. At the Rocky Mountain National Park near Denver 54 per cent of the travel is from Colorado; at the Yosemite 94 per cent is from California. Obviously most public places that are near densely settled areas and that do not charge admission fees are largely patronized by local people. If,

[10] A. E. Taylor: The Balance of International Payments of the United States in 1933, *U. S. Bur. of Foreign and Domestic Commerce Trade Information Bull. No. 819*, 1934.

however, as Ogilvie asserts,[11] services are more important than goods, it makes little economic difference whether the tourists come from near or far. New Hampshire records are shown in Table II. Isolated and scattered as such compilations are, they offer clues to the increases or decreases in the volume of the tourist movement as a whole.

Sportsmen and Snow Trains

Although amateur fishermen and hunters, skiers, mountain climbers, yachtsmen, and the like do not regard themselves as tourists, the study of tourism in its economic and geographical phases would be incomplete if these folk were left out of the picture.

Estimates of the number of off-season visitors may be arrived at from licenses issued to fishermen and hunters, who constitute a source of revenue after the summer decline of tourists. According to the State Development Commission New Hampshire from 1920 to 1928 issued 27 per cent of all such licenses to nonresidents, at an average of 36,395 a year for the nine years; the money value of these 27 per cent equaled 55 per cent of the license receipts. In 1929 nonresident receipts totaled $100,980, resident receipts $80,073. In Michigan during 1929 some 400,000 small-game hunting licenses and 70,000 deer hunting licenses were issued.[12] In 1931 there were some 220 hunting and fishing clubs in Michigan, using 169,613 acres of land, upon which the tax levy was $38,807.81.[13] Increasing attention is being given in many states to the utilization of wastelands for game preserves.

A special type of off-season tourism that has developed in the last few years deserves a word of comment. For the benefit of skiers, skaters, and snowshoers, the Boston and Maine Railroad instituted in 1931 the first "snow trains," and similar trains were run from New York in 1934. This represents a response to a growing movement in New England and elsewhere to capitalize the winters. In 1931 during ten Sundays and one holiday between January 11 and March 22 inclusive snow trains carried 8371 persons from Boston for day's outings in New Hampshire. In 1932, 10,314 persons took part in snow-train excursions from Boston during February and March.

Estimates of Tourist Expenditures

The only available estimates of tourist expenditures have been obtained through questionnaires. According to the Bulletin of the Colorado Association, from 1183 answers to a questionnaire an average per capita expenditure of $115.46 was reached for Colorado. The

[11] *Op. cit.*, p. 41.

[12] K. C. McMurry: The Use of Land for Recreation, *Annals Assn. of Amer. Geogrs.*, Vol. 20, 1930, pp. 7–20; reference on p. 9.

[13] W. O. Hedrick: Recreational Use of Northern Michigan Cut-Over Lands, *Michigan State College Agric. Exper. Sta. Special Bull. No. 247*, 1934, p. 27.

average stay in weeks was found to be 2.95, which gives an average weekly expenditure of $39.11 per capita. In 1929 the per capita expenditure in Maine was found to be $90.55, and in 1930 $96.84; the average weekly expenditure per capita for both years was $53.80. California reports a per capita expenditure of $208.08 during 1928,

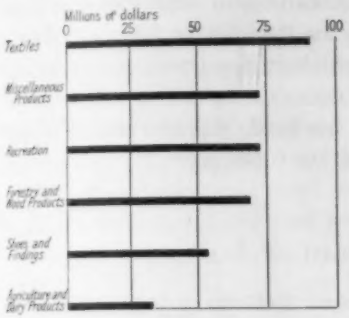

FIG. 1

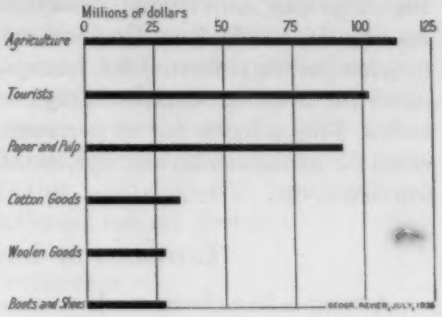

FIG. 2

FIG. 1—Value of New Hampshire Industries. From Department of Publicity, Concord, N. H.
FIG. 2—Value of Maine Industries. From a Primer on the Recreational Industry of Maine.

the Dominion of Canada Bureau of Statistics reports $114.77 for the same year, and New Hampshire reports $53.00.

Estimates of total expenditures by tourists have been obtained by multiplying the number of tourists entering a state by the average expenditure per capita, a method that does not, of course, take into account the amount expended by tourists from within the state borders. On the basis of expenditures the value of the "recreational" industry in New Hampshire was estimated for 1932 by the State Development Commission and is shown in Figure 1 in comparison with the values of other industries. A similar graph for Maine appears in Figure 2. It is the general belief in New England that only the metal and textile industries bring more money into the region than is derived from its recreational facilities.

OTHER VALUES INVOLVED

Tax returns yield a clue to the value of property held by summer residents. In Maine taxes on real estate used for recreation amounted in 1929 to $15,093,132 to nonresidents not citizens of Maine, $5,058,404 to permanent residents, and $3,762,908 to nonresident citizens of Maine (i.e. owners of summer homes in one town but of permanent homes in another). A thorough investigation of this subject made in Connecticut showed the total number of holdings for summer residences in 1930 to be 34,802 and their total assessed value to be more than $130,000,000.[14] From the maps in the report it may be seen that

[14] N. L. Whetten and V. A. Rapport: The Recreational Uses of Land in Connecticut. *Storrs Agric. Exper. Sta. Bull. 194*, 1934, pp. 9 and 16.

in 12 towns of the state the area devoted to summer homes and lots was 25 per cent or more of the total area of the town and in 28 towns the assessed value of summer homes and lots was 25 per cent or more of the total assessed value.

According to the New England Council, the $500,000,000 that the American Automobile Association estimates was spent in 1932 by vacationists in New England may be divided as follows:[15] $100,000,000 (or 20 per cent) for transportation; $100,000,000 (or 20 per cent) for accommodations; $125,000,000 (or 25 per cent) at retail stores; $105,000,000 (or 21 per cent) for food; $40,000,000 (or 8 per cent) for amusements; and $30,000,000 (or 6 per cent) for confections, souvenirs, etc.

Estimates of Length of Stay

Attempts have been made to measure tourism in terms of person-days. This involves considerable bookkeeping; but if comprehensive statistics of tourist person-days could be compiled, the data they would provide concerning the relative magnitude of the tourist movement in different regions would be more reliable than mere estimates of expenditures. The requisite information might be obtained by at least three different methods: (1) study of the records of hotels, lodginghouses, etc.; (2) inquiries made at political boundary lines; and (3) questionnaires. At state borders the second method would involve much labor and questioning that would probably be disagreeable to the tourist. At international frontiers, where many data are collected anyhow, the problem would be simpler. The questionnaire method has been employed by a few states. Error is unavoidable, since a questionnaire is a mere sampling of the tourists and at best includes only a very small percentage of them. No satisfactory conclusions, for example, could be reached on the basis of the 700 answers to a recent Maine questionnaire received from among 1,250,000 visitors. To 6000 letters sent out by Colorado authorities 1183 replies were received, involving 3894 people; their total length of stay was 11,495 weeks, or an average of 2.95 weeks. Ogilvie suggests an ingenious method of tabulating dates of arrival and departure and finding from them the average length of stay.[16]

Advertising and Tourism

Advertising is becoming a more and more powerful force in the promotion of tourism. State publicity bureaus, chambers of commerce, towns, railroads, etc. are all contributing to a "literature"

[15] Second All New England Recreational Advertising and Publicity Campaign, New England Council, Boston, 1933.

[16] *Op. cit.*, pp. 106–110.

that is already amazingly large and is rapidly becoming altogether overwhelming. The New England Council, acting for all the New England states, during 1932 began a "recreational" advertising and publicity campaign, which has grown in power and dignity.

Attempts are being made to find out what attracts the tourist. In one such effort, using the questionnaire method,[17] ten "recreational appeals" were listed for checking. In order of rank these appeals were: natural surroundings; good food; healthful climate; reasonable rates; quiet, comfort, and rest; modern conveniences; sports; courtesy and service; historic places; social activities. The states covered by this sampling were Maine, New Hampshire, and Vermont. It is questionable, however, whether such "appeals" are inclusive enough on the one hand and specific enough on the other.

An Invitation

Tourism is to be regarded as a definite form of land utilization and one, furthermore, of rapidly growing importance. From the geographer's point of view the study of tourism offers inviting possibilities. There is scope for the development of new and ingenious techniques of research and for the discovery of facts of value in their social implications in what is virtually a virgin field.

[17] L. W. Chidester: New England's Recreational Appeals, New England Council, 1930.

THE DISCOVERY OF KING KARL LAND, SPITSBERGEN

Adolf Hoel

FIG. 1—King Karl Land, Spitsbergen, reduced from the chart of Northern Svalbard by the Norges Svalbard- og Ishavs-undersøkelser, Oslo, 1934.

King Karl Land is east of Spitsbergen, between latitudes 78° 38′ and 79° N. and longitudes 26° 24′ and 30° 20′ E. of Greenwich. It is probable that the constituent islands were first sighted in 1617 by the English whaler Thomas Edge, who gave them the name of Wiches Land. This early discovery, however, shortly fell into oblivion.

Rediscovery of King Karl Land has been ascribed to Skipper Elling Carlsen of Tromsö in 1859. When hunting seals in the waters east of Spitsbergen in his brig *Jan Mayen* Carlsen sighted the land on July 21, and the next day he was only two geographical miles south of it. In 1863 he saw it again, this time from the northwest. In 1864 it was seen by Skipper Sivert Tobiesen of Tromsö, and the same year it was sighted from Kvitberget on the east coast of Spitsbergen by A. E. Nordenskiöld and N. Dunér. Also, the Englishman, E. Birkbeck, claims to have seen it that year. In 1870 the islands were sighted by the Germans Theodor von Heuglin and Graf Waldburg Zeil, who named them König Karls Land after the king of Würtemberg. The next year Skipper A. Ulve of Tromsö saw the islands. In 1872 Skipper Nils Johnsen of Tromsö succeeded in making a landing on King Karl Land; and the same summer the skippers J. Altmann and J. Nilsen, both of Hammerfest, were near the islands, and Nilsen circumnavigated them. On the basis of these and earlier observations Professor Mohn in 1872 compiled the first map of the land and named it after King Karl XV of Norway and Sweden.

In 1889 King Karl Land was seen by the German zoologist W. Kükenthal and by Skipper Heming Andreassen of Tromsö, who discovered Rivalen Sound; and in 1897 it was seen by the Englishman Arnold Pike. In 1898 a Swedish expedition led by Professor A. G. Nathorst made an accurate map of the islands and carried out scientific investigations. Since then King Karl Land has been visited by a number of sealers and hunters, some of whom have wintered there. In 1930 the Norwegian expedition to Franz Josef Land led by Dr. Gunnar Horn made a landing on the easternmost island of the group.

However, this belief that King Karl Land was discovered by Elling

Carlsen in 1859 and that the first landing was effected in 1872 has turned out to be wrong.

On April 14, 1931, the Norwegian Institute for the Scientific Exploration of Svalbard and the Arctic Sea (Norges Svalbard- og Ishavs-undersøkelser) received a letter from the director of the Navigation Service of the Norwegian Navy, Captain Fr. Schulz, calling attention to a copy of a letter found in the archives of the service at Horten. The original document was found in the archives of the Ministry of Defense and was handed over to the institute.

A translation of the text of this interesting—one might almost say sensational—document reads as follows:

Tønsberg, November 4th, 1859.

To the Royal Norwegian Government's Navy Ministry.

As I have supposed that this probably would interest the high Department, I most humbly beg to submit the following report.

Having cruised for several days in a N.N.E. direction from Ryk Yses Island [on the east coast of Edgeøya (Spitsbergen)], I came on July 27 this year under 2 islands, whose existence is not found plotted on any chart of the Arctic Sea. The most southerly island extended in the direction of N.N.W. and S.S.E. by compass, the southern point of which was found to be in latitude 78° 37′ N. and longitude 27° 20′ E. of Greenwich. I estimated the island to be at least 9 miles [the Norwegian sea mile of 4 nautical miles] in circumference.

We landed upon it and while we tried to row around it in the boats I discovered to the north of it a still larger island, whose southern part had the shape of a semicircle. I could not, however, find out how far this island extended northwards as the land was entirely surrounded by ice in that direction. The islands were separated by a strait 3 Miles across. Otherwise the land was quite high with projecting lowlands in several directions, besides which a number of smaller islands and rocks were located at the northern land. It may also be mentioned that in 1853 I sighted land from a high mountain on Stands Foreland [Edgeøya] in the direction mentioned above, but I assumed it to be the land which was discovered by Commander Gilles in 1707. He states it to be very high, and in a way it is marked down on the maps of the Arctic Ocean. I therefore did not find it peculiar at all. Lying 23 Miles off the position stated, however, it can hardly be the same land, but is doubtless another land more to the north. Especially as the error is north-south, and he, most likely, has sighted it from Northeast Land or Tafel Berg.

However this may be, it is quite certain that these islands have not been previously visited. Personally I wish that I shall be able to go to these islands quite often, as I found there what I was looking for: the ice and the waters around these islands teeming with walruses, seals and polar bears, and being fitted out for such hunting, I made quite a fine catch during the few days I was staying there.

NB: A northeasterly gale on August 2 pushed me 5–6 Miles off the islands, which were then surrounded by ice. I thus got into more than 100 fathoms of water, and no more animals were seen. Although I continued cruising there for 17 days no change occurred, and owing to the late season I was compelled to leave the place for this year. I tried once more around Thousand Islands until August 26, but without results, and then the cruise was shaped for home.

I am, dear Sirs, Yours most obediently

E. Eriksen
Captain of the Arctic Seafaring brig Nordbye of Tønsberg.

According to the latitude and longitude given by Skipper Eriksen the newly discovered land is without doubt the present King Karl Land. Thus Eriksen discovered King Karl Land six years before Elling Carlsen and made a landing there 13 years before any other explorer. He went ashore on the Svensköya (Swedish Foreland) and so discovered Rivalen Sound 30 years before Heming Andreassen.

The latitude given by Eriksen for the southern point of King Karl Land differs only 1 minute or 1.85 kilometers, and the longitude 37 minutes or 13 kilometers, from its position on modern maps. He gives 9 miles as the circumference of Svensköya, whereas it actually is 7 geographical miles, and three geographical miles or 22.2 kilometers as the width of Rivalen Sound, whereas according to the most recent surveys it is 25 kilometers. His description of the land is also good.

Eriksen's discovery is also of interest as showing the small importance attached to such discoveries in the Norway of those days. Professor Mohn and the German geographer Dr. Petermann were the first to call attention to the geographical discoveries made by the Norwegian sealers in the latter half of the last century. And it very often happened that the sealing skippers kept their discoveries a secret to prevent competitors from invading their new hunting grounds.

Skipper Eriksen had considerable reputation as a sealer, especially for his ability to find good hunting grounds. In the search he went farther northwards than was usual at that time and always returned with his ship loaded. On his voyages he saw plenty of whales, but with the whaling gear of that time he could not catch them, and he was led to the construction of a whaling harpoon, a model of which he made in wood. However, the wealth and honor that he had expected from his invention passed him by, and his discovery of a new land in the north, which he himself accounted of great value, from both an economic and a geographical point of view, was ignored. For a long time he looked forward to an answer from the government, but none came. These disappointments preyed on his mind, and eventually he emigrated to the United States. Here he lived by doing odd jobs until he perished during a snowstorm in the Dakotas in the winter of 1887–1888.

UNIVERSAL WORLD TIME

Helen M. Strong

National Resources Board, Washington, D. C.

THE advent of radio has made most of the people in every country aware that the time of day at any one instant is different in various parts of the world. When a radio in New York is tuned in at 7 p. m. to listen to Big Ben in London, Big Ben strikes midnight. On a passenger liner in the Pacific that happened to be crossing the 180th meridian at this moment many of the passengers would doubtless be confused in their minds as to whether today was yesterday or tomorrow! In the course of answering an inquiry at the United States Coast and Geodetic Survey about the origin and status of the international date line it became apparent that there were few, if any, general statements on the subject of standard time. This paper has therefore been written from material gathered together from scattered sources in the Library of Congress and the library of the Coast and Geodetic Survey, and its purpose is to explain the necessity for a systematic standardization of local times, to give a brief historical outline of the development of such standardization, and to indicate with suitable references the present status of international time.

The Greenwich Meridian Used First for Purposes of Navigation

Before the discovery of America opened an era of world-wide exploration, precise determination of longitude, which defines the difference of time between two places, was not essential. Ships either coasted from point to point or, by observing for latitude, a comparatively simple process, maintaining a compass course, and keeping the log of distance covered, sailed by dead reckoning to the desired latitude and then followed this latitude to port.

The search for new lands in the age of discovery carried ships over unknown seas out of sight of land for weeks and often months. Under these conditions a course laid by dead reckoning accumulated large errors. Mariners called insistently for a means of determining their longitude or time while at sea.

Spain, Holland, and England in turn offered large rewards for a solution of this problem. When Charles II of England heard of a plan to use the stars as a clock with the moon moving among them as the hands, he ordered Flamsteed to investigate. Flamsteed reported the method to be feasible, but impracticable with existing instruments and star tables. Thereupon the King, in 1675, appointed Flamsteed as Astronomer Royal, founded the Greenwich Observatory, and directed the "Rectifying the Tables and Motions of the Heavens and Places of the Fixed Stars."[1]

When the first issue of the Nautical Almanac was published in 1765, 10,000 copies were sold immediately. The sextant was made more precise, and study leading to the construction of accurate "time-keepers," which are the chronometers of today, was encouraged. Soon explorers such as Cook and Vancouver and all the ships of the Royal Navy carried timekeepers regulated at Greenwich and set to Greenwich time. Thousands of English charts on which longitude was laid off from Greenwich were published and sold to be used with the Nautical Almanac and the timekeepers. Britain led the world in the number of merchant ships on the seas, and they of course used Greenwich time. As time passed a steadily increasing number of ships reckoned longitude and time from the Greenwich meridian, until, in 1884, it was used by 65 per cent of the world's shipping and 72 per cent of its tonnage.[2]

[1] E. W. Maunder: The Royal Observatory, Greenwich, London, 1900, p. 23.

[2] International Conference Held at Washington for the Purpose of Fixing a Prime Meridian and Universal Day, October, 1884: Protocols of Proceedings, *48th Congr., 2nd Sess., House Ex. Doc. No. 14*, p. 45.

Today it is standard the world over for navigators, and it is interesting to note that as early as 1850 the United States by Act of Congress adopted Greenwich time for navigators.

But on land things were very different. France used a different system of longitude, based on Paris, until just before the war, and many countries under French influence used this system until then. In the United States and Canada a century ago each community went on its own local time, which sufficed for all its needs. About seventy years ago observatories in Washington, Cincinnati, Cambridge, Albany, and New York began to furnish time to railroads, jewelers, and government offices.[3] But the time of these observatories was not uniform. No one place for the United States, much less for the world, was recognized as the point from which time was reckoned.

In the United States and Canada the railroad and telegraph nets were expanding. The use of 75 different standards of time caused the time problem to become so acute that a country-wide regulatory time standard was demanded by scientists, engineers, railroad companies, and commercial organizations, though it was quickly realized that because of the wide east-west extent of North America one time would not suffice for the whole continent and that systematic time zones would have to be introduced.

Movement for Adoption of Standard Time

At the meeting of the British Association for the Promotion of Social Science held in Manchester in September, 1866, on motion of David Dudley Field of New York a committee was appointed to prepare and report to the Association the outlines of a code of international law, later to be presented to the various governments for their sanction. This included consideration of universal time. In 1871 Mr. Field completed a draft of this report, which he presented to the international Association for the Reform and Codification of the Law of Nations (the successor of the British Association for the Promotion of Social Science).[4] Plans for such a universal standardization of time were proposed independently by Professor Cleveland Abbe of the United States Signal Service and Dr. Sandford Fleming, chancellor of Queen's University, in 1878. In 1879 the American Metrological Society adopted a system offered earlier by Professor Benjamin Peirce, superintendent of the United States Coast Survey, which proposed one standard for every hour of longitude west of the Greenwich meridian.

In June, 1881, at the Montreal meeting of the American Society of Civil Engineers Dr. Fleming presented the subject of international time. A committee was appointed to obtain an expression of opinion on the desirability of establishing a common time standard for the world. Letters were sent to scientists and others concerned in the adoption of such a system. Replies unanimously favored a common time system for each continent and were 95 per cent for a world standard. On August 17, 1881, the international Association for the Reform and Codification of the Law of Nations, meeting at Cologne, appointed a committee to consider resolutions submitted to it regarding adoption of a uniform time throughout the world. This plan was approved by the American Metrological Society, the American Geographical Society, the Canadian Institute, and the Imperial Academy of Sciences at St. Petersburg and was considered by the Royal Society of London and the American Association for the Advancement of Science.

The American Metrological Society and the Canadian Institute meanwhile appointed delegates to the International Geographical Congress at Venice in Septem-

[3] J. K. Rees: The International Time-System, *Trans. New York Acad. of Sci.*, Vol. 1, 1881–1882, pp. 86–95; reference on p. 86.

[4] F. A. P. Barnard: Standard Time, *Proc. Amer. Metrol. Soc.*, May, 1881, p. 1.

ber, 1881. Dr. Sandford Fleming, representing Canada, presented a paper and resolutions indicating the importance to geography and navigation of uniform world time and one prime meridian. Immediately after this the American Geographical Society and the American Metrological Society prepared and circulated for signatures petitions addressed to the Congress of the United States. Early in the spring of 1882 these petitions, bearing several thousand signatures, were laid before Congress.

The seventh International Geodetic Conference, meeting at Rome in 1883, recommended the adoption of the Greenwich meridian as the reference meridian. In North America, thanks largely to the efforts of Sandford Fleming, standard time was "first introduced in railway economy."[5] The railroads of the United States and Canada on November 8, 1883, united in adopting mean local times of the 75th, 90th, 105th, and 120th meridians west of Greenwich as the standards of time for the operation of their roads.

At their May, 1882, meeting in Washington, D. C., the American Society of Civil Engineers adopted a committee report recommending "that steps be taken to obtain the establishment of a zero meridian, to be common to all nations for reckoning time and longitude, and that concurrence in this measure be sought from as many nationalities as may be induced to assist in this determination; that efforts be made to lead to the acceptance of this course on the other continents to the fullest extent; that failing in this effort, the people of the Western Continent determine a zero meridian for their own use and guidance, and especially with a view to establishing a system of Standard Time."[6]

As a result of all this agitation, an act was passed by Congress and approved August 3, 1884, authorizing President Arthur to invite governments of all nations with whom the United States held diplomatic relations to appoint delegates in Washington, "for the purpose of fixing upon a meridian proper to be employed as a common zero of longitude and standard of time reckoned throughout the globe."[7]

The International Meridian Conference

The International Meridian Conference, upon this invitation, assembled in Washington in October, 1884. The assembly represented users of many different prime meridians—Greenwich, Paris, Cadiz, Naples, Christiania, Ferro, Copenhagen, Rio de Janeiro. After thoughtful deliberation, weighing the merits of each meridian and the advantages of a prime meridian and universal time for the world, the Conference decided that it was desirable to adopt a single prime meridian for all the nations; that this should be the meridian passing through the center of the transit instrument at Greenwich; and that longitude should be counted 180 degrees east and 180 degrees west of this meridian. The Conference also proposed adoption of a universal day for the world to begin at mean midnight on the Greenwich meridian and suggested that astronomical and nautical days, which up to this time were counted from one noon to the next, should begin at mean midnight.[8] Thus the present world system of time reckoning first was accorded concerted international recognition.

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[5] Sandford Fleming: The Unit Measure of Time, *Proc. and Trans. Royal Society of Canada for the Year 1890*, Vol. 8, 1891, Section 3, pp. 3–6; reference on p. 5.

[6] Association for the Reform and Codification of the Law of Nations, The Committee on Standard Time, 1882, pp. 10–11 and 13–15.

[7] International Conference Held at Washington, p. 1.

[8] *Ibid.*, pp. 1 and 111–113. Actually astronomical time beginning at noon was used in the various national ephemerides until 1925, and the change at that date caused considerable confusion in the nomenclature of time. In astronomical circles Greenwich mean time is still reckoned from noon and is the same as Greenwich civil time in that it uses the same length of day, namely the mean solar day, but is different in that civil time is reckoned from midnight.

Universal World Time

Six years after the International Meridian Conference determined on Greenwich time as the universal world time it had been adopted in North America by nearly all communities. In Asia it was legally established throughout the Japanese Empire. In Europe, Sweden and Great Britain were using it, and Austria-Hungary, Germany, and Belgium were about to adopt it on their railroads. Since that time one nation after another has accepted this universal time, now a necessity in the constant communication by telephone, telegraph, and radio and in transportation by air, rail, motor, and water. Arabia, Ethiopia, Persia, Afghanistan, and the Polar Regions, and a few small countries and islands—notably Holland, Newfoundland, Java, Bolivia, and Paraguay—are the only areas where it does not now prevail. In China the coastal regions and the Yangtze Valley follow universal time, though it is not used in the interior.[9]

In conformity with the system adopted at the International Conference, the earth is divided into 24 hourly zones. Thus the governing meridians are spaced at intervals of 15 degrees, beginning with the prime meridian (zero degrees) at Greenwich, and each time zone extends 7½ degrees on each side of its governing meridian.

Time-zone charts published by the principal maritime countries show which nations are under the legal universal time system; those where time differs from it by half an hour; those that have not adopted the zone system in any form; and places where legal time either is not known or is not kept. On the oceans each zone generally conforms exactly to the specified boundaries. Exceptions include a few island groups such as the Carolines in the Pacific Ocean[10] and the Kurile Islands and Sakhalin which take their time from Japan instead of following that of the zone in which they lie.

On land the zones approximate the 15-degree width but deviate frequently to coincide with country or regional boundaries. For instance, the British Isles, Belgium, France, Spain, Portugal, the Ivory Coast, and the Gold Coast use the same hour as Greenwich, though their international boundaries do not follow the bounding meridians of this zone. Sweden and Norway, which together cover more than 15 degrees, as well as all of Central Europe, begin their day one hour ahead of Western Europe. Although British South Africa and Mozambique together lie in three time zones, for convenience both use the time of the middle zone. Likewise Argentina, instead of dividing its time according to the two zones over which it spreads, uses that of Buenos Aires and the Pampa, where most of the people live.

The alignment of time zones in North America is an expression of commercial regional relations, though it approximates the 15-degree bands. Originally Detroit, Cleveland, and Cincinnati used Central standard time, but business in these cities found it more convenient to set its clock with Eastern standard time; this is therefore the legal time in Michigan and Ohio, and northern Kentucky uses the same hour where it borders Ohio. Mexico lies for the most part in the zone designated Mountain time in the United States; but because its transportation and other economic relations are chiefly with the Central time zone of the United States, Mexico, with one exception, uses the Central standard time of the United States. The exception is northern Lower California at the California-Mexico border, where Pacific time is kept.

The eastern boundary of the Pacific time zone of the United States and Canada shows the regional influence of a great mountain range, where it follows the crest of the Rocky Mountains.

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[9] Time Zone Chart of the World, *U. S. Hydrogr. Office Chart No. 5192*, 8th edit., 1933.

[10] The discussion of deviations from 15-degree zones is based on Hydrographic Office Chart No. 5192. See also R. E. Gould: Standard Time Throughout the World, *U. S. Dept. of Commerce, Bur. of Standards Circular No. 406*, 1935.

The Date Line

In a voyage round the world dates have to be adjusted somewhere in the course of the voyage. The convenience of adjusting the date in an uninhabited ocean tended to establish the Pacific Ocean as the customary place of change; with the adoption of universal world time, in practice, the day was considered to begin at 180 degrees, the antimeridian of Greenwich, and now all changes of date for travelers across the Pacific Ocean occur at this line, or along certain custom-established deviations.

Professor George Davidson, formerly assistant in charge of the United States Coast Survey Office in San Francisco, after his retirement in 1895 corresponded with all countries in the Pacific Ocean to find out which kept Asiatic and which American time. This investigation first definitely located the points where the date line departs from the 180th meridian.

The results of Professor Davidson's study appear upon the August Pilot Chart of the North Pacific Ocean published by the United States Hydrographic Office, July 25, 1899. The caption reads: "The line separating the lands of the Pacific where American date is kept from those where Asiatic date is kept." The copy of this chart in the Library and Archives of the United States Coast and Geodetic Survey carries in Davidson's own handwriting the title "The so-called International Date Line."

In the archives of the American Geographical Society is an interesting letter from Professor Davidson on the subject. It is dated from San Francisco, August 6, 1899, and runs as follows:

In the Hydrographic Pilot Chart of the Pacific Ocean for *August* you will find an Inset map with the title

> "The line separating the lands of the Pacific where American date is kept from those where Asiatic date is kept" 'c.

It is a rather curious heading but it is not mine. About a year ago some one came to me to inquire about "the *International Date Line was on the Pacific*". By this the Inquirer meant in what longitude do ship masters change their date & day: and altho' I said 180° from Greenwich, it set me thinking, because I knew there were exceptions: especially among the Aleutian Islands: and I knew that Samoa had been reckoned among the time Isds. of the Australian group.

So I hunted the matter up and wrote a lecture for my class: but it was many months before I got even satisfactory answers. And very curiously I found in the International Cyclopedia of *1894* that they carried the theoretical line from *180° away round the Filipinas* because the discovery was made by Maghallanes from the W.! And that Cyclopedia copied from another authority of 1880! They did not know that the change had been made at Manila, Jay 1, 1845! Nor did any one seem to know when the *Russian church* changed the day & date in Alaska after we bought the Territory: nor that we carried the line to include Wrangell land &c &c. Altogether it was a curious investigation, because I found that the Samoan King, urged by an American firm doing business at Samoa, had declared two *fourths of July* in 1891 (or 2,) and brought the Isds. back to what we here call Pacific Coast time.

Moreover I found that the two best German maps of 1897 gave the line differently.

When I found that American steamships, French, German, Russian, were settled upon one usage I wrote to the Hydr. Bureau, told of my examinations &c some 2 or 3 months ago: and the other day had a note from Capt. Craig in charge Hy. office: saying they had many queries such as I had &c. & you see the result. The blank space below the inset map seems to me to have held an explanation, that had finally been "washed out". That is briefly the history of nearly a years writing. There is no International Date line: The theoretical *change of date line* would be 180° from Greenwich: the Line actually used is the agreement among the commercial steamships of the countries name & is perhaps adopted by the naval vessels, so that all "logs" will be in accord.

Yours vy truly

George Davidson

The date line deviates from 180 degrees in three places.[11] It swings through Bering Strait so as to place the eastern tip of Asia in one time zone. Thence it runs directly southwest to the end of the Aleutian Islands, so that all these islands and the extreme western peninsulas of Alaska may have the same hour. The third deviation is in the south, where the date line swings eastward 7½ degrees so as not to complicate time in the Fiji Island group and in New Zealand.

Although this line is used by navigators of all nations, there seems to be no general agreement concerning the name of "the line," no international agreement has defined it, nor have the nations formally sanctioned it. International custom, however, seems to have located and informally adopted it. In general, except for minor deviations, navigators of all nations use the same line.

Daylight-Saving Time

Daylight saving is a recent adaptation of the time-zone system, originated during the World War as a measure of economy and retained by a desire on the part of certain urban populations for more hours of sunlight after the working day is over. It is effective only in mid-latitudes during the summertime, when sunrise is early, sunset late, and twilight long.[12] Many communities and regions in the United States and Canada[13] and in several European countries and also in Argentina have adopted the measure. Some communities have permanently moved their time into that of the next zone eastward and so observe throughout the year what is, in effect, daylight-saving time; for instance, on the Canadian Pacific Railway all towns from Crowsnest, B. C., to Kootenay Landing, B. C., use Mountain time in place of Pacific time throughout the year. In addition to the urban communities, daylight-saving time is being increasingly adopted by summer resorts.

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[11] Notes on the History of the Date or Calendar Line, *New Zealand Journ. of Sci. and Technol.*, Vol. 11, 1929–1930, pp. 385–388.

[12] Compare S. W. Boggs: Seasonal Variations in Daylight, Twilight, and Darkness, *Geogr. Rev.*, Vol. 21, 1931, pp. 656–659. See also L. C. Harrison: Daylight, Twilight, Darkness, and Time, New York, Newark, etc., 1935; reviewed elsewhere in this number of the *Geographical Review*.

[13] The Official Railway Guide of the Railways and Steam Navigation Lines of the United States, Porto Rico, Canada, Mexico, and Cuba, May, 1935.

AMERICAN GEOGRAPHICAL SOCIETY

The March Meeting. The regular monthly meeting of the American Geographical Society was held on March 26, 1935, at the Engineering Societies' Building, 29 West 39th Street, Mr. Philip W. Henry, Chairman of the Council, presiding. Captain Peter Freuchen delivered a lecture entitled "The Eskimos as I Know Them." Captain Freuchen has spent nearly thirty years living among, and dealing with, the Eskimos and probably knows them more intimately than any other person. His lecture, illustrated with lantern slides and motion pictures, dealt chiefly with their daily life and their traditional customs and folklore.

The April Meeting. The regular monthly meeting of the Society was held on April 23, 1935, at the Engineering Societies' Building, 29 West 39th Street, Mr. Henry presiding. Dr. Robert Cushman Murphy, Curator of Oceanic Birds at the American Museum of Natural History, delivered a lecture entitled "Mountain and Seacoast in Ecuador." Dr. Murphy has made a special study of the geography and climate of the west coast of South America in their relation to the abundant bird life of the coast and coastal islands. It was his good fortune to be in Ecuador in the early part of 1925 when abnormally high temperatures in the southward-flowing, warm current resulted in a period of heavy rainfall on a normally rainless coast. His lecture, which was illustrated with lantern slides and motion pictures, was mainly on the effects of this rainfall on the vegetation of the coast and the disastrous effect of the unusually warm offshore waters on the bird life.

Election of Fellows. At the April meeting of the Council of the Society the names of 35 candidates were presented who were duly elected as Fellows of the Society.

Election of Honorary and Corresponding Members. At the meeting of the Council of the American Geographical Society held on May 28, 1935, three elections were made to the Society's list of Honorary Members and nine to the list of Honorary Corresponding Members.

Honorary Members

Alexander Forbes, professor of physiology at the Harvard Medical School, has made important contributions to the geographical knowledge of northern Labrador. In 1931 he conducted the Grenfell-Forbes Expedition, with which the Society was closely connected and on which the method, developed at the Society, of mapping in mountainous country by means of high-oblique aerial photographs was given a thorough field test. In 1932 he was responsible for further field work in Labrador, and plans are now under way for continuation of the work.

William Archibald Mackintosh is professor of political and economic science at Queen's University, Kingston, Ontario. His studies and writings deal mainly with Canadian economics and economic geography. As Director of Research of the Canadian Pioneer Problems Committee organized in connection with the American Geographical Society's research program in problems of pioneer settlement and financed by the Social Science Research Council, he was responsible for the carrying out of a comprehensive program of studies resulting in a series of nine volumes on "Canadian Frontiers of Settlement."

Rafael Aguilar y Santillán is permanent general secretary and editor of the Sociedad Mexicana de Geografía y Estadística and honorary president, perpetual secretary, and librarian of the famous Academia Nacional de Ciencias "Antonio

Alzate" in Mexico City, of which he was one of the founders. The present high standing of these two institutions is in large part due to his devotion to them, to the important libraries that he has assembled in both, and to his editorial work on their publications.

Honorary Corresponding Members

Hans W:son Ahlmann is professor of geography at the University of Stockholm and secretary of the Swedish Society for Anthropology and Geography. He has made geomorphological, glaciological, and climatic studies in Norway and has done important work in the geographical study of ancient and modern settlement in various parts of Europe. He was leader of the Swedish-Norwegian Arctic Expedition in 1931, which explored Northeast Land and the waters as far as Franz Josef Land.

Carlos M. Delgado de Carvalho is professor of social sciences at the Colegio Pedro II in Rio de Janeiro. After serving for a number of years in the meteorological service of the Brazilian government he turned to the educational field. As a teacher he has been particularly concerned with the geographical aspects of the social sciences and with the training of teachers of geography and the development of geographical instruction in the public-school systems of Brazil.

Charles Carlyle Colby, professor of geography at the University of Chicago, has been a teacher of teachers of geography for the past twenty-five years. His interests have been mainly in the field of economic geography, and he is the author of several books and numerous articles on the subject. He served the Association of American Geographers as its secretary from 1924 to 1933 and is its president for the current year.

Osbert Guy Stanhope Crawford is archeology officer of the Ordnance Survey of Great Britain. He has manifested a continuing interest in the geographical aspects of archeology. Through his initiative and under his direction large use has been made of aerial surveys for archeological purposes and techniques have been developed for the interpretation of archeological features on photographs taken from the air. He is the founder and editor of *Antiquity*.

Charles Bungay Fawcett is professor of economics and regional geography at the University of London. His special fields are population studies, regional geography, and political geography, to which he has made important contributions through his lectures and writings. At the International Geographical Congress at Warsaw in 1934 he was president of the section on human geography.

Nevin M. Fenneman has been professor of geology and geography at the University of Cincinnati since 1907. His geographical studies have been mainly in the regional field. The delineation of the physiographic provinces of the United States for which he was responsible as chairman of a committee of the Association of American Geographers appointed for the purpose has been widely accepted as a standard of its kind and widely used as a basis for further regional studies.

Lawrence Martin is chief of the Division of Maps and incumbent of the Chair of Geography at the Library of Congress. His early interests were chiefly in physiography, particularly in its glaciological aspects. More recently as drafting officer and geographer in the Department of State from 1920 to 1924 and as chief of the Division of Maps at the Library of Congress he has concerned himself with the geography of international affairs and foreign trade as well as with the study of interstate boundary disputes in the United States and the history of the cartography

of the United States. He has served as expert in a number of interstate boundary negotiations and now is a member of the Executive Committee of the Advisory Committee to the Division of Geographic Names of the United States Department of the Interior.

CARL ORTWIN SAUER is professor of geography and head of the Department of Geography at the University of California. His work is notable for its depth and originality. His paper on "The Morphology of Landscape," dealing with methods and objectives in geographical research, has evoked wide discussion. He is probably best known for his contributions to the study of land utilization. Through his initiative the Land Economic Survey of Michigan was organized, and during the past year he has prepared for the Science Advisory Board of the National Research Council a fundamental report on "Land Resource and Land Use in Relation to Public Policy."

CAMILLE VALLAUX was formerly professor of geography at the École des Hautes Études Commerciales and at the École Libre des Sciences Politiques in Paris. He is one of the many distinguished pupils of Vidal de la Blache and has especially cultivated the human side of geography in its social, political, and historical aspects. A distinguishing feature of his most recent work "Géographie générale des mers" is the development of the human aspects.

Election of Councilor. At the meeting of the Council of the Socie y held on May 28, Dr. Isaiah Bowman, President of the Johns Hopkins University, former Director of the Society was elected Councilor of the class of 1938.

An Expedition to the Yukon Territory. An expedition to the Yukon Territory has been organized and is going out this summer under the leadership of Mr. Walter A. Wood. Amongst the objects of the expedition is an experimental photogrammetrical survey in the little-known region lying between Kluane Lake and the International Boundary. The expedition is under the auspices of the Society.

The Millionth Map of Hispanic America. Ten new sheets of this map are now in the hands of the lithographer, and it is expected that they will be ready for distribution by the end of July. The new sheets consist of four in the Argentine Republic (Córdoba-Santa Fé, South H-20; Rosario, South I-20; Mar del Plata, South J-21; and Golfo de San Matias, South K-20), three in Brazil (Rio Juruena, South C-21; Goyaz, South D-22; and Paranapanema, South F-22), two in Central America (Ciudad Guatemala, North D-15; and Belize, North E-16), and one in Mexico (Culiacán, North G-13).

When these sheets are printed sixty sheets of the map will have been published. The drafting work on the remaining forty-two sheets is sufficiently advanced so that the lithographing and printing can proceed steadily until the entire map is completed. It is expected that the last sheet will be published by the end of June, 1936.

GEOGRAPHICAL RECORD

NORTH AMERICA

First Flight to St. Lawrence Island, Alaska. For the clue it may hold to early folk movements St. Lawrence Island has attracted much interest in the last few years. Readers of the *Geographical Review* will recall, for instance, Mr. Henry B. Collins' article on the early Eskimo culture of the island (H. B. Collins, Jr.: Prehistoric Eskimo Culture on St. Lawrence Island, *Geogr. Rev.*, Vol. 22, 1932, pp. 107–119). The present writer has carried out archeological work on the island during the past eight years (Bunnell-Geist Bering Sea Expeditions and Alaska College Expeditions to St. Lawrence Island). For the 1934 season's work it was planned to continue

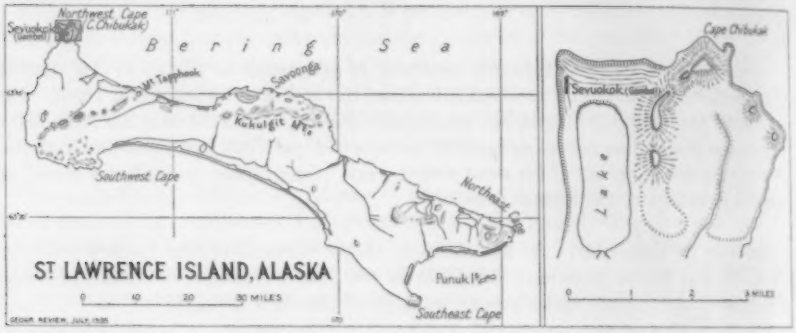

FIG. 1—Sketch map of St. Lawrence Island, approximately 1 : 2,200,000, based on the author's map, 1 : 140,000 (obtainable from the museum department of the Alaska College). The inset shows the northwestern corner of the island and available landings for aircraft. Small planes can make east-west landings on the northern beach; grading would be needed for large planes; the lake affords an excellent landing for seaplanes and could be used by planes equipped with skis most of the winter.

excavating at the ancient village of Kukulik four miles east of Savoonga. An effort was to be made to reach this difficultly accessible island by air, a trip that has always been viewed with misgiving by aviators on account of the almost continuous fog overlying Bering Sea, especially near St. Lawrence Island, at certain times of the year and the sudden changes in weather frequently experienced in this particular sub-Arctic region. The island is exposed to the storms of Bering Sea and is especially at the mercy of northerly storms, which come down through the funnel-like Bering Strait and strike St. Lawrence with full force.

On July 15, 1934, we essayed the first flight to St. Lawrence Island. After a three-hour flight over Bering Sea, and probably over the island itself, we had to return, for the island was invisible through the enveloping fog.

On July 17, 1934, our second and successful flight was made. Our pontoon-equipped plane took off from Port Safety lagoon near Nome, Alaska, with a load of four passengers and baggage. We found the entire northern coast line of the island covered with heavy fog, through which penetrated three peaks that I recognized as Northeast Cape. Crossing over, we saw the three tiny islets of the Punuk group. As we flew inland from east to west on the south side of the mountains of Northeast Cape and the Kukulgit range we found the island itself comparatively free from fog, a phenomenon I have noted many times during my work on the island. In the crater of one of the extinct volcanoes of the Kukulgit Mountains we saw a small blue-green lake. Toward both the south and the north slopes of this range extensive lava flows could be seen. One of the peaks that we measured in 1933, Mt. Atok, is 2070 feet, and it is not the highest in the range.

We flew over the Kukulgit range and arrived at the north shore of the island about five miles west of Savoonga. Forced down by the lowering fog, we flew close to the ground; but it was obviously impossible to make a safe landing on the beach at Savoonga because of the heavy breakers, and we again turned westward. We flew over Mt. Tapphook, about 1200 feet high, skimmed over large lagoons and several hunting camps, and eventually made out the precipitous head of Northwest Cape. By a flight around the cape it was a simple matter to locate the fine large lake behind it. We circled twice over the village of Sevuokok (Gambell) to get the "feel" of the wind and landed from the south. After alighting, the plane taxied up to the north beach of the lake, which is about two and a half miles long and about a mile wide.

The lake is deep and has fine sandy beaches on the north, south, and west shores. Only along the side of the cape mountain is the shore strewn with sizable boulders. This body of fresh water is large enough to accommodate almost any kind of amphibian, flying boat, or pontoon ship in almost any weather, since it is well protected from most storms. Small planes could also land on the sand bars once the pilots were familiar with the ridges of a succession of old beach lines.

St. Lawrence Island is dotted with numerous lakes and lagoons from one end to the other. Many of these are deep enough for small planes to use. For some time during our flight we could see the large lagoon of the south side of the island, which, although shallow in places and only about a mile in width, is almost fifty miles long. This lagoon could be used for emergency landings by even large planes.

The total time consumed in this flight was a little more than three hours. About an hour and a half were spent between Nome and St. Lawrence Island, and about the same amount of time was required to fly the length of the island from East Cape to Northwest Cape. In a straight line, the distance is close to one hundred miles.

OTTO WM. GEIST

Wild-Life Restoration in the United States. That "there is incontrovertible evidence of a critical and continuing decline in our wild-life resources, especially migratory waterfowl, due to the destruction and neglect of vast natural breeding and nesting areas by drainage, the encroachment of agriculture, and the random efforts of our disordered progress toward an undefined goal" is the belief of the President's Committee on Wild-Life Restoration. "Drainage operations, intended to bring more land under cultivation, have directly destroyed millions of acres of former breeding grounds, and by lowering of water tables, have indirectly destroyed millions of acres more." Grazing and mowing and fires have destroyed many nests with the net effect that "the natural increase from propagation no longer equals the annual losses from all causes." A national wild-life program is advocated that is believed to be "economically justifiable and immediately practical by utilizing submarginal and commercially unprofitable agricultural lands now contributing so largely to the surplus of agricultural products." It recommends the acquisition by lease and purchase of vast areas suitable for migratory waterfowl and shore-bird breeding and nesting and for development as upland game areas and of certain areas known to be used as breeding and nesting places by nongame birds; the acquisition of land for the restoration of big game; the creation of a wild-life division out of existing personnel; and the establishment of subsistence farm homes on all areas acquired, farmers to serve as caretakers (Report of the President's Committee on Wild-Life Restoration, U. S. Dept. of Agriculture, Washington, 1934).

A recent study of the waterfowl situation throughout the United States and Canadian breeding grounds states that "in North America the great natural migratory-waterfowl breeding grounds once reached as far south as central Nebraska; but . . . [in 1934] the excessive drought . . . practically eliminated all breeding in the area south of a curving line that extends across the Prairie Provinces of Canada." To assist visualization of the present unfavorable situation "as a basis for effective action

looking to the perpetuation of an adequate and satisfactory waterfowl supply," a series of twenty-four maps has been prepared "to show the principal breeding grounds of the more important species and the areas in the United States and Canada over which they are hunted for sport" (W. B. Bell and E. A. Preble: Status of Waterfowl in 1934, *U. S. Dept. of Agric. Misc. Publ. No. 210*, 1934).

The Division of Migratory Waterfowl has been organized as a new unit of the Bureau of Biological Survey to plan and develop a restoration program. Reconditioning the Mississippi flyway and the restoration of that part of the waterfowl nesting grounds lying in the United States are the first considerations. Twelve great nesting refuges have thus far been planned, with a combined area of some 300,000 acres. Other types of refuges include the 50,000-acre Mattamuskeet Lake, N. C., an area almost as large in the White River country, Ark., and the Lake Malheur region, Ore. Numbers of other refuge sites are being negotiated for, with a goal of a million acres of migratory-waterfowl refuges set for 1940 (J. C. Salyer II: A Program of Waterfowl Restoration, *U. S. Dept. of Agric. Circular No. 339*, 1934).

A study of game management in all its ramifications has recently been written by Aldo Leopold (Game Management, Scribner's, New York, 1933). It is an attempt "to describe the art of cropping land for game and to point the way toward its integration with other ends in land-use." There are sections dealing with the history of management, properties of game population, fluctuations and cycles, game range, measurement of game population and productivity, game refuges, control of hunting, predators, food and water, diseases, game economics and esthetics, and game administration, and finally game work as a profession. Of interest also is Leopold's "Report on a Game Survey of the North Central States" (Madison, Wis., 1931), a description of "game conditions as they exist, the opportunities which those conditions offer, the human machinery available for acting on them, and the probable consequences of their further neglect." Both volumes contain numerous maps and graphs.

The story of the development of migratory-bird protection has recently been outlined by J. C. Phillips (Migratory Bird Protection in North America, *Special Publ. Amer. Committee for Internatl. Wild Life Protection*, Vol. 1, No. 4, 1934). It may be noted here that among the recommendations of the President's Committee was one looking to a treaty with Mexico similar to that with Canada—a recommendation also endorsed by the Select Committee on Conservation of Wildlife Resources. (For the organization and work of this Committee see "Wildlife Conservation," *74th Congr., 1st Sess., House Rept. No. 1 (Union Calendar No. 2)*, 1935, and *Conservation of Wildlife. Hearings before the Special Committee . . . 73d Congr., 2d Sess.*, 1934).

Mount Mazama and Crater Lake. The life history of Mt. Mazama, now represented by the caldera of Crater Lake, may be read in the alternating layers of lava and glacial material forming the rim of the caldera. The story is told by Wallace W. Atwood, Jr., in "The Glacial History of an Extinct Volcano, Crater Lake National Park" (*Journ. of Geol.*, Vol. 43, 1935, pp. 142–168). It begins in mid-Tertiary time and involves four or possibly more glacial stages interspersed with periods of vulcanism. In the process of reduction to the present caldera form it is estimated that 15 cubic miles of material disappeared, probably by engulfment near the close of the Pleistocene. In a following brief period of activity the Wizard Island cinder cone was built, since when there has been no activity in the immediate neighborhood. Crater Lake, now occupying the caldera, is nearly 2000 feet deep. Typical sections around the rim of the caldera are described and illustrated with sketches and photographs. A map showing the direction of glacial striae pertaining to the last glaciation reveals a major convergence over the center of the lake with a secondary center over Wizard Island; the map for an earlier glaciation shows a similar major convergence but no secondary center.

The beauty of Crater Lake and the attraction it offers to visitors (J. C. Merriam: Crater Lake: A Study in Appreciation of Nature, *Amer. Mag. of Art*, Vol. 26, 1933, pp. 357–361; E. A. Rostel: Crater Lake—An Epic in Volcanology, *Natural History*, Vol. 33, 1933, pp. 66–74) deepen the interest in its history. It is, however, interesting not only in itself but as a key to the history of other volcanoes of the Cascades and of other parts of the world where similar conditions exist and also for the chronological possibilities it offers.

The Carolina "Bays." In an article entitled "'Carolina Bays' and Elliptical Lake Basins" William F. Prouty (*Journ. of Geol.*, Vol. 43, 1935, pp. 200–207) presents further evidence tending to confirm Melton and Schriever's theory of the meteoritic origin of the Carolina "bays" (*Journ. of Geol.*, Vol. 41, 1933, pp. 52–66; compare the note "Meteorite Scars," *Geogr. Rev.*, Vol. 23, 1933, pp. 499–501). The bays, it will be recalled, are elliptical depressions whose long axis regularly trends northwest-southeast; they are sand-rimmed, the rim or rims (double or triple rims in some) being higher and broader at the southeast end. They have no relation to topography and are as well preserved on the inner as on the outer border of the Coastal Plain. Magnetometer readings show a positive anomaly to the southeast of most of the bays, generally at a distance from the rim about equal to the length of the short axis. The anomalies, some of them high, are generally weaker nearer the coast, and the suggestion is made that a buried meteoritic body would there disintegrate more rapidly on account of the salinity. More detailed and extensive mapping, however, is required before the meteoritic theory can be definitely established.

Rain Makers and Drought. The advance of settlement into the Great Plains during the two decades following the Civil War occurred in a period of increasing rainfall. The opinion gained wide currency that the change in climate was due to the spread of cultivation. A leading advocate of the theory was Professor Samuel Aughey of the University of Nebraska. Aughey, who was not unscientific in method and point of view, discarded "a wide-spread popular conception . . . that every yard of steel rail laid in the desert would draw from the heavens a gallon of water per annum." He maintained, however, and aimed to prove by experiment that cultivation greatly increases the power of the soil to absorb moisture and that this increase in soil moisture causes a marked increase in rainfall. "Several hundred thousand copies of descriptive pamphlets prepared by Aughey were promptly circulated by the railroads" and doubtless attracted many settlers into regions subsequently blasted by the droughts of the late eighties and nineties. The theory as developed by Aughey and carried to extremes by his contemporaries is discussed by Walter Kollmorgen in an entertaining article on "Rainmakers on the Plains" in the *Scientific Monthly* for February, 1935 (pp. 145–152).

Cyclic changes in rainfall and some of their effects in the western part of the United States were discussed in the January, 1935, number of the *Geographical Review* (pp. 43–61, 152–155). Reference may also be made to a brief summary of the outstanding features and results of the great drought of 1934 in a paper by L. H. Block on "The Record-Breaking Drought, Heat, and Dust Storms of 1934" (*Bull. Amer. Meteorol. Soc.*, Vol. 15, 1934, pp. 300–307). The drought, with its associated dust storms, ruined crops and led to the slaughter of innumerable head of cattle. It also "took its toll of wild plants," though native plants and trees "on the whole suffered less than the short-rooted introduced crops." Nevertheless, "millions of dead trees are to be seen—the toll of a flameless forest fire." An area equal to one-third of the state of Rhode Island was burned by genuine forest fires, which by July had increased 66 per cent "over the average for the past three years." "The Colorado [River] was exceptionally low and the Red River of the North was completely dry in certain sections where steamboats once plied." The uneven dis-

tribution of the areas of deficient precipitation is illustrated by the fact that the "Columbia river, . . . fed by the abundant Northwestern precipitation of the past cool season, was reported as carrying more water than all the streams of the arid region combined." Lowered water levels in the Great Lakes (except Lake Superior) seriously interfered with navigation, and "outlets of sewers left high and dry became a menace to health." The drought added greatly to the nation's burden of emergency relief. "And as is to be expected, the highest percentage of relief in any State is to be found in South Dakota, hard hit by cumulative drought of 3 to 5 years. There 34% of the population are receiving help, and 20 to 21% in North Dakota and Minnesota, respectively, the other two states at the center from which the tendrils of the drought seemed to have radiated." It is possible that the calamity may give an impetus to westward migration into the better-watered areas of the Northwest. "The Seattle Chamber of Commerce, along with railroad companies reported that many inquiries had been received concerning Oregon, Washington and Alaskan lands."

Four detailed precipitation maps of the northern Great Plains in the Dakotas, Montana, and Wyoming are presented by W. A. Mattice (Precipitation in the Northern Great Plains, *Monthly Weather Rev.*, Vol. 62, 1934, pp. 445–447). In addition to the average annual precipitation they show certain quantities and ratios that are more critical in relation to agriculture and grazing, namely: average warm season precipitation, percentage of the average annual precipitation that occurs in the warm season, and percentage of years with less than 15 inches of precipitation. Local variations are pronounced in every case. The area least favored as regards all four factors extends southward into Wyoming and northward into Montana from near the center of the Wyoming-Montana boundary line. Curves of annual precipitation (five-year moving averages) for selected stations offer some encouragement, since they show that former dry periods—some of which have exceeded in severity that of the present time—are invariably followed by years of increased precipitation.

Soil blowing is probably the most serious of the evils to which the repeated droughts have given rise, for when the top soil is blown away the land is often rendered permanently worthless for farming or grazing. How soil blowing may be checked by special methods of tillage and the local use of protective shelter belts of trees is explained by C. E. Kellogg in a pamphlet entitled "Soil Blowing and Dust Storms" (*U. S. Dept. of Agric., Miscellaneous Publ. No. 221*, Washington, 1935).

Water-Supply Problems in Southern New England. Denser populations requiring larger water supplies force engineers into closer figuring on minimum yields from city watersheds. Two decades ago an addition was made to the Hartford water supply, which in the dry period 1929–1932 failed to provide the "safe" minimum computed for it from the experience of 15 to 35 years at Wachusett and Sudbury—the years used included one of the wetter periods in long rainfall fluctuations. The problem is considered by C. M. Saville in a paper entitled "Some Phases of Southern New England Hydrology" (*Journ. New England Water Works Assn.*, Vol. 47, 1933, pp. 363–448). Mr. Saville emphasizes the importance of determining the general position of a rainfall record in the major up or down swings of rainfall over a period of 50 to 100 years or more. For such a comparison the century-long Amherst rainfall record is most helpful; for a general local check, tree rings are useful. An even longer time setting is obtained from the rough opposition apparent between decade means of British rainfall and of a synthetic Boston record over the past 180 years.

On his particular problem, the water supply for Hartford, Conn., Mr. Saville brings to bear an array of methods with which he determines with fair success how often Hartford's water supply will become dangerously low. In the last half century there have been three serious droughts, but the chances of two consecutive years as dry as 1930–1931 (80 per cent of the normal) are only 1.2 a century. It might

seem that such a high percentage for minimum rainfall should leave nothing to worry about; the runoff, however, in these dry years was only 60 per cent of the average, and the rainfall collected only 37 per cent. Furthermore, the yield from rainfall depends very much on how it is distributed between the cold-season accumulation period and the warm-season transpiration and evaporation period. Thus the sixth driest year in the Sudbury rainfall record of 58 years, 1899, yielded more than average water: there was heavy snow in February. The twentieth wettest year, 1925, however, yielded only three-quarters as much water: its wetness was chiefly in summer.

A rainfall map of southern New England based on selected stations for which there were published data available for the whole or part of the 50-year period 1878–1927 is presented with the detail possible with an isohyetal interval of one inch. The belt of heavier rainfall across the south a few miles in from the coast is very evident. Although the author purposely omitted topographic considerations, the map looks peculiar in the western mountain area, where the rainfall of the dry valley stations is spread evenly across this rugged region.

CHARLES F. BROOKS

North Pacific Meteorology from the Modern Viewpoint. H. C. Willett's "American Air Mass Properties" (see *Geogr. Rev.*, Vol. 24, 1934, pp. 154–156) represents the longest step taken to date in the interpretation of the weather of the North American continent in terms of the Norwegian synoptic meteorology. Willett's study of the Pacific coast was incomplete in that it did not make use of synoptic material from over the Pacific Ocean. This gap has now been largely filled by a paper by Horace Robert Byers, "The Air Masses of the North Pacific" (*Bull. Scripps Instn. of Oceanogr.*, Technical Ser., Vol. 3, No. 14, 1934, pp. 311–353).

Aerologic data, on which the accurate definition of air-mass properties depends, are of course lacking from the open ocean; Byers has had to make the best of observations made at stations in the Pacific states and the Hawaiian Islands and otherwise to depend on "indirect aerology," to use Bergeron's happy term. He nevertheless succeeds in presenting a convincing picture of the North Pacific air masses and their interaction, particularly within the oceanic area included in the Weather Bureau's Pacific-coast base map and over the coastal strip of the continent. He deals only with winter synoptic situations, in which the air masses as they emerge from their source regions are polar continental (Pc) and tropical maritime (Tm). Polar-maritime air (Pm), the most frequent mass in the northern part of the area, is originally Pc that has taken on heat and moisture in its lower parts from the sea surface and so has become convectively unstable. The modifications undergone by Pc and Pm along the North American coast are complicated. Byers systematizes these modifications by defining a "cold" and a "warm" type of modified-polar-continental air (Npc) and a "moist" and a "dry" type of modified-polar-maritime air (Npm). The cold type of Npc is Pc that is only slightly modified in the direction of Pm, and the warm type is Pc that has been foehn-warmed in descending to the coast from the high western interior of the continent. The moist type of Npm results from the cooling of Pm over the sea during a passage northward after an earlier warming during a southward trajectory, by which cooling the characteristic convective instability of Pm is destroyed. The dry type of Npm is Pm that has had a good deal of its moisture precipitated in ascending to the western plateaus and that returns to the coast as a dry mass. Most originally Tm air appears in the northern part of the ocean in a modified state, as Ntm, cooled and so stabilized in its lower layers. Fresh, convectively unstable Tm, either aloft or extending to the ground in the warm sector of a cyclone that is not yet occluded, appears occasionally along the California coast, to yield heavy rains in the mountains of the southern part of the state.

Most of the twenty-five synoptic charts reproduced in Byers' paper cover the

eastern Pacific only, from about the longitude of Dutch Harbor eastward. One series, however, consists of analyses of the daily weather charts issued by the Japanese Imperial Marine Observatory and so covers the entire ocean north of the equator. On this series of maps a representative cyclone may be followed from its origin as a wave disturbance on a front parallel to the Ryukyu Islands through the gradual process of occlusion as it crosses the ocean to the interaction of its now modified air masses with the masses encountered in the Gulf of Alaska and along the North American coast. This series is the most illuminating one reproduced; it indicates that the North Pacific part of the generalized map of air masses and fronts published in the recent summary work of the Norwegian meteorologists (V. Bjerknes and others: Physikalische Hydrodynamik mit Anwendung auf die dynamische Meteorologie, Berlin, 1933, Fig. 130, p. 708) should be considerably revised. JOHN LEIGHLY

The Climate of the Prehistoric Southwest. Of interest to students of the past climates of the Southwest is a paper by Florence M. Hawley on "The Significance of the Dated Prehistory of Chetro Ketl, Chaco Cañon, New Mexico" (*Univ. of New Mexico Bull., Monograph Ser.*, Vol. 1, No. 1, July 1, 1934). Dr. Hawley has here brought together a number of references bearing on the prehistoric climate of the Chaco and contributes a few observations of her own. Although at the present day no pines are found nearer than thirty miles, yet in 1923 Dr. Douglass discovered two pines in a side canyon, which have since been cut down. He suggested that pine forests once covered this area. In support of this idea Dr. Hawley points out other evidences of a retreating forest, such as dead trees on the forest margin and the greater variation of the rings in beams from the last building period of the pueblo, which would indicate increasingly hard conditions for growth. Also, in excavating the middens at Chetro Ketl she found charcoal fragments from household fires that proved to be branches of Douglas fir, yellow pine, and piñon trees, which no longer grow in or about Chaco Canyon. It is inconceivable that a large population such as existed in the Chaco in the eleventh century without beasts of burden would have traveled very far for their fuel. All of this points to increasing desiccation. The tree-ring record between 945 and 1100 shows many recurrent droughts, but they proved to have little or no effect on the building program at Chetro Ketl.

HAROLD S. COLTON

AFRICA

Coöperative Research in African Geography. "Co-operative Research in Geography: With an African Example" by Alan G. Ogilvie (*Scottish Geogr. Mag.*, Vol. 50, 1934, pp. 353–378) reports the work of a committee of the British Association appointed in 1926 to carry out investigations on the human geography of intertropical Africa. "We set ourselves to state clearly the points upon which information was badly needed, and then proceeded to lay plans for tapping a body of knowledge which we believed to exist in Africa . . . " A carefully prepared questionnaire was sent out to district officials, missionaries, and others. Mr. Ogilvie illustrates the results with a synthesis of data received from Northern Rhodesia.

From the individual responses it is possible to build up a picture of the annual rhythm of vegetation and animal life, the seasonal activities of the population, and the seasonal regime of the waters. Population density is greatest where agriculture can be supplemented by some other activity, especially fishing. Islands in Lake Bangweolo, where fishing predominates, have 80 persons to the square mile. Similar high densities are recorded of other water bodies. The great alluvial plains of the Barotse, the Kafue flats, and the reserves east of the Luangwa are relatively populous areas in which cattle are held by the cultivators. These regions, of course, are free of the tsetse fly, which infests large areas of the country.

If the agricultural village must be close to water, it must also have access to a supply of wood: the natives are truly "men of the trees." One important question relates to the modification of the natural vegetation. The characteristic system of shifting agriculture is the cause of the degeneration of the savana woodland. Wood is also used for many domestic purposes. The report on the Mongu of the western plateau says that "bark comes more frequently into daily life than anything else; . . . consumption is enormous and must be responsible for the destruction of thousands of trees and saplings every year." Millet is the food staple that involves the maximum destruction of timber and impoverishment of soil: the general life of the millet-raising village is only three or four years. The government is encouraging the cultivation of manioc as ensuring greater stability, and the crop is also less susceptible to drought. Manioc has come in from the west, as is suggested by the cartograms of food staples (millet, sorghum, maize, manioc). Together with the square or oblong house, it has been brought by the steady drift of migrants from Angola that has been under way since 1917. The chief external influences on native culture, however, are due to British rule, settlement by European farmers, and exploitation of minerals in the copper belt. As indicative of trends, a cartogram shows the distribution of the European-type house, the continuation or otherwise of the old native iron industry, and the native labor movements.

Italian Colonization in Libya; The Jebel Nefusa. Except for a few scattered oases in the Sahara, the only habitable parts of Libya are two narrow strips near the coast (see *Geogr. Rev.*, Vol. 19, 1929, pp. 329 and 411). Contemporary efforts to colonize these regions are discussed in a recent volume by a French geographer, Jean Despois (La colonisation italienne en Libye: problèmes et méthodes, Larose, Paris, 1935). The situation is clearly presented in its geographical and economic settings. The Great Syrtis, which separates Cyrenaica from Tripolitania, "is incontestably one of the most marked natural and human frontiers in the world." Cyrenaica is like "a piece of Europe set down in Africa." On its plateaus Mediterranean forests, maquis, and conifers of northern varieties are found. The level tracts are well suited to stock—neat cattle, sheep, and goats—and under irrigation cereals and vegetables may be raised. In Tripolitania the climate is drier and less stable; large areas are steppelands, either worthless or of use only as poor pasture; in the cultivable parts dry farming and arboriculture offer agricultural possibilities, but irrigation is almost wholly out of the question. One might expect under such circumstances to find a predominance of sedentary villagers in Cyrenaica and of nomadic or seminomadic herders in Tripolitania, but the opposite is the case. Cyrenaica has lain for centuries at the mercy of desert tribes from the east. In Tripolitania Berber villagers have managed to maintain themselves in the highlands despite almost constant struggles with the Bedouins, and along the shore a string of agricultural villages has enjoyed some measure of protection under the governments in Tripoli, a town whose existence in past centuries may be ascribed in large part to its trans-Saharan trade.

Italy acquired title to Libya in 1911. The pacification of Tripolitania was not completed until after the World War, and Cyrenaica was not reduced to law and order until 1931. As a consequence, the movement of Italian settlers into Cyrenaica has only just begun. At first the government's purpose in Libya was economic colonization—the development of the country by capitalist concessionaries with the aid of native labor. In 1928 a policy of "demographic colonization" was substituted, which called for the establishment of Italian peasant proprietors on the land. Not much good farm land is available at best, and peasants can be placed upon it only at a great cost in loans and subsidies. In Tripolitania efforts are being concentrated on the introduction of the olive. Fifteen to twenty years are required before new olive groves become productive. Meanwhile the farmers have to live, largely at the expense of the government. Despois points out that most of the trees

set out have been procured from nurseries in Italy. The peasants are familiar with these trees, and the native stocks are too scarce to meet the demand. There is no definite assurance, however, that the Italian trees will thrive under African conditions. Nor is there assurance of a continuing demand for olives and olive oil in the world's markets. The hazards are great.

In Cyrenaica the problem is not one of awaiting a future era of productivity, since irrigation and stock raising offer possibilities of an immediate return on the investment. The main trouble here is want of capital and remoteness from markets. The best farming areas are on the uplands, from which the ports are not easily accessible.

The Jebel Nefusa, a long cuesta bounding the coastal lowland of Tripolitania on the south, is the subject of an excellent monograph by the same author (Jean Despois: Le Djebel Nefousa (Tripolitaine): étude géographique, Larose, Paris, 1935). This "mountain" supports a relatively dense Berber population, who subsist on their olive, fig, and palm groves, and on their stock. Irrigation in the strict sense is little practiced, but, instead, ingenious methods are employed to guide and utilize the runoff with the aid of walls and embankments along the slopes. Rural habitations in the Jebel Nefusa are concentrated in villages perched on the crests of the ridges for protection from nomad raiders. Many of the habitations are troglodytic. There has been, indeed, a marked shifting of the population into natural and artificial caves during recent years. This movement gained impetus at the time of the World War, when the Italian troops were withdrawn from the region. During this period the "Arab" nomads, seeking revenge on the Berbers for their adherence to the Italian cause, massacred many of them and destroyed their houses. Despois believes that the same type of life has persisted in this region almost unchanged since early times. "More than history, religion, or language, its mountainous character . . . has lent profound originality and a force of resistance to the Nefusa."

The Banana Industry in French West Africa. Twenty years ago bananas were a luxury and almost a curiosity in France, but recently there has been an extremely rapid increase in their consumption. More than 225,000 tons were imported in 1932 as compared with 5700 tons in 1908. Only a small part came from French colonies: 17,500 tons from French Guinea, somewhat more than 11,000 from Guadeloupe, and 4500 from Martinique; the remainder came from outside French possessions (G. Annet: La production bananière en Afrique occidentale française, *Rev. de Botanique Appliquée & d'Agriculture Tropicale*, No. 149, Vol. 14, 1934, pp. 1–8). That France is looking to her colonies for further development of the industry is indicated by the recent literature on the subject. Many factors enter into the problem, such as suitable climate and soil, satisfactory labor supply, means of transportation on land, and shipping facilities such that the bananas reach their destination in good condition. Of the French possessions, those in the West Indies and West Africa come closest to filling the requirements—particularly West Africa, since distance from the home market is a drawback to development in the Antilles. South of Dakar climatic conditions are suitable; but, although the climate of the Ivory Coast is also good, development has been hindered by the lack of a good port, among other things, and, furthermore, Grand Bassam is about 800 miles farther from France than Conakry is. It is probable that single-tenant projects on such a large scale as those of Central America will not be feasible in West Africa in general, largely because of the topography. There are exceptions, such as the region north of the Rio Nuñez estuary. Here rainfall is inadequate but irrigation is possible (P. Bourgoin: La culture du bananier et les colonies françaises, *Rev. Gén. des Sci.*, Vol. 44, 1933, pp. 711–716). On the whole, however, concessions held by a single tenant are not large, often ranging from 15 to 50 hectares. The holdings are found chiefly in the valley sections of the district across which the railroad cuts. Nearly

half of the tonnage exported to France comes from the centers Friguiagbé, Kindia, and Kolenté (L. Brossat: La culture du bananier en Afrique occidentale française, *L'Agronomie Coloniale*, Nos. 177, 178, and 180, 1932; 181 and 182, 1933). Formerly bananas imported by France came largely from the Canary Islands. The cultivation on Grand Canary and especially the carefully regulated means of irrigation are described by Maurice Appert (Le bananier à la Grande Canarie, *ibid.*, Nos. 197–199, 1934). The author has also written recently a useful little manual on banana growing (Le bananier et sa culture, Larose, Paris, 1933).

ASIA

River Problems of Northern China. Two years after the greatest flood disaster in China's history, the Yangtze and Hwai floods of 1931 (Republic of China: Report of the National Flood Relief Commission 1931–1932, Shanghai, 1933), there occurred "what was probably the largest flood since 1887 or maybe 1851" on the Yellow River. More than 3000 villages were destroyed and 2,500,000 people rendered destitute in Honan, Hopei, and Shantung in this 1933 flood.

The problems of China's northern rivers, the Hwang Ho, the Hwai, and the Hopei systems, are interrelated. Elsewhere in this number of the *Review* (pp. 367–381) reference is made to the problem of those rivers that converge on Tientsin. "The Yung Ting Ho problem is serious enough in itself to be a first class engineering problem threatening as it does vast agricultural interests and communication facilities such as the Peiping-Tientsin railway and the navigable Hai Ho which makes Tientsin the leading sea port in north China. Even Tientsin city itself will in time be endangered by this land building force. This uncontrolled river also makes uncertain almost any improvement undertaking on the Ta Ching Ho, Hsi Ho and Pei Yun Ho, all tributaries to the Hai Ho. Next to the Yellow river problem it is the most urgent river problem in the north requiring solution" (Sig. Eliassen: The Northern River Problem in China, *Journ. Assn. of Chinese & American Engineers*, Vol. 14, No. 3, 1933, pp. 21–28; reference on p. 23).

From the agricultural point of view the Hwai River problem is even more important; while "the Yellow river hangs as a Damocles' sword over the whole issue."

Writing on the Yellow River problem, S. Eliassen emphasizes the need of further studies both in the laboratory and in the field (Flood Flow of the Yellow River, *Journ. Assn. of Chinese & American Engineers*, Vol. 15, No. 5, 1934, pp. 18–38). Scour and deposition are extremely complex operations (compare John Leighly: Turbulence and the Transportation of Rock Débris by Streams, *Geogr. Rev.*, Vol. 24, 1934, pp. 453–464). Above all it is the erosion phase of the problem "which really forms the stumbling block to all efforts to master the control of the northern rivers." Analysis of present available data makes it clear that the worst offender in the matter of silt is the King tributary of the Wei Ho. Mr. Eliassen observed on this stream a silt content of 48 per cent, even 51 per cent at one time; and 30 per cent silt was carried for several consecutive days. The King River drains parts of western Shensi and eastern Kansu where the loess is thickest; its western watershed is the lofty Liu Pan Shan, which receives a heavy rain from easterly winds; the fan shape of the basin concentrates runoff. The stream is characterized by extremely "flashy" flow: a rise of 10 meters in less than 10 minutes is recorded. The Lo Ho is also a large silt contributor, and the Wei Ho itself, apart from these two tributaries.

Floods are more spectacular calamities in northern China but droughts are more frequent and take a greater toll of life. The northwest provinces, Kansu, Suiyuan, Shensi, and Shansi, are distinctly dry. There are no accurate rainfall records, but available data for recent years indicate an average annual precipitation of about 12 inches, and along the Yellow River at Suiyuan it may drop as low as 6 inches. In the Wei Pei region of Shensi the average seems to be less than 15 inches, and it

drops to 8 inches in dry years. Distribution of precipitation is unfavorable. Generally there is not enough in spring; in summer, even if the total fall is enough, it is apt to be too concentrated and hence destructive. The soil, too, is highly erosive, but, on the other hand, it is fertile, with good capillary action, and is excellent for cereal crops. Extensive areas unfortunately are unsuitable, for both topographical and hydrological reasons, for large irrigation developments. However, there are four regions where the Chinese have fostered irrigation projects in past centuries—namely at Ninghsia, Hao Tao, the Wei Pei in Shensi, and the Taiyuan Valley in Shansi. In all these areas except Hao Tao the remnants of the old works still remain and the old native methods are still followed, but with greatly decreased efficiency. At Hao Tao most of the old work has been abandoned, and the population that once dwelt there has left. At Saratsi, immediately to the east, however, a new irrigation project has recently been completed. Our attention has been called to this and other projects in a communication received from Mr. Walter H. Mallory.

The Saratsi project, begun in 1929, was designed to give at least partial relief to an area of nearly 330,000 acres of flat farm land lying south of the Peiping-Suiyuan Railway and north of the Yellow River immediately east of Tengkow. The silt content is low here, only one per cent in flood, one-tenth of that at low water. Navigation is a consideration, and the system has been planned to accommodate canal boats (O. J. Todd: Famine Prevention and Relief Projects, *Far Eastern Rev.*, Vol. 28, 1932, pp. 361–373).

The Wei Pei plain is the granary of Shensi. Twenty-one centuries ago an irrigation system was worked out here involving a diversion of the King River several miles below the gorge where it enters the plain. In the course of time diversion had to be pushed upstream to the gorge, beyond which it could not proceed by the primitive methods available. Eventually the intake from the river was closed some 300 years ago. The severe drought of 1920–1921 in Shensi focused attention on the problem (W. H. Mallory: China: Land of Famine, *Amer. Geogr. Soc. Special Publ. No. 6*, 1926). Finally the silt problem was solved, and the project was completed in 1932 with an area of 90,000 acres under irrigation (see S. Eliassen and O. J. Todd: The Wei Pei Irrigation Project in Shensi Province, *China Journ.*, Vol. 17, 1932, pp. 170–180; also "The Wei Pei Irrigation Work," *Far Eastern Rev.*, Vol. 29, 1933, pp. 60–71). The contribution of Western science to this work began with the topographical surveys. The mechanical apparatus used for constructing the tunnel and the use of concrete in the dam were importations. The work, however, was all done by Chinese with but one resident foreign engineer in charge.

On the Fen River irrigation in the past depended on natural flow, water being diverted as needed by temporary earthen dams. The present project calls for a dam on the upper Fen at Hsiachingyiu above Taiyuan, three reservoirs for storing the winter flow for spring irrigation, and four irrigation areas (O. J. Todd: Regulation of the Fen Ho for Flood Protection and Conservancy of Winter Flow as an Aid to Irrigation, *Far Eastern Rev.*, Vol. 30, 1934, pp. 165–171 and 221–230). While the Fen Ho presents the major water-conservancy problem in Shansi, projects could be carried out with advantage on some of the other rivers of the province as O. J. Todd describes in "Four Rivers of Shansi" (*Far Eastern Rev.*, Vol. 31, 1935, pp. 62–69).

The Foreign Trade of China in 1934. The March, 1935, number of the *Chinese Economic Journal* is devoted to analyses of the foreign trade of China for the past year. It is not a bright picture. "China's foreign trade has shown a steadily downward trend since 1929, when the world economic depression began to take serious shape. The figures dropped tremendously after 1931, in consequence of the loss of the Three Eastern Provinces, through which territory about one-tenth of China's imports and one-third of her exports passed." This last year "the worst enemy was again flood and drought . . . To make matters worse, heavy shipments of silver

from China strained the money-market to an unprecedented degree." Exports valued at 535 million dollars in 1934 represent a decline to 40 per cent of the figure for 1926; imports valued at 1030 million dollars in 1934 to 59 per cent of the figure for 1926. In exports the greatest losses have been in soybeans, cereals, and raw silk. In current order of importance the chief exports are tea, cotton yarn, metals, eggs and egg powder, skins and furs, raw silk; the leading imports are metals, raw cotton, rice, machinery, chemical products, kerosene. The United States, Japan, and Great Britain are the leading participants in Chinese foreign trade, together accounting for nearly half the total. Japan, however, has declined to second place since 1931 by reason of the noninclusion of figures for trade with Manchuria. Hongkong claims fourth rank, as a transshipping center (see Ho Ping-Yin: A Survey of China's Trade with Hongkong, *Chinese Economic Journal*, April, 1935). While still showing the largest share in exports it has declined heavily in imports, which are tending to go into China direct. Of Chinese ports Shanghai still is outstanding, accounting for 55 per cent of the total trade. Tientsin is second with 11 per cent.

Ti-li Hsueh Chi-kan: The Quarterly Journal of Geography. The Geographical Department of Sun Yat-sen University, Canton, China, has begun the publication of a quarterly journal of geography. The purpose, as stated in the "Opening Remarks" in the first number, is threefold: to publish results of original research and translations and discussions of contributions by foreign scholars in the field of geography, to supply teachers in secondary schools with material, and to discuss problems of educational policy in regard to geographical subjects. The first three numbers of the *Journal*, those of March, June, and September, 1933, which have come to the attention of the reviewer, contain a number of articles of considerable interest.

Despite the extraordinarily rich accumulation of knowledge and scientific tradition in the field of historical geography and the recent rapid advances in geological research, modern geographical studies in China are still in an embryonic stage of development. Chinese geographers are working in a virgin field, and rewards of labor are generous. For instance, in his lengthy article entitled "An Outline Study of the Commercial Geography of China Based upon the Statistics of China's Foreign Trade" (March and June numbers) Professor Wang Chung-chi, though making use of familiar material, has produced significant results, particularly by his historical approach. Take the question of the relative importance of the northern and the southern ports. Professor Wang's study reveals that in the last sixty years the positions of the ports in South China and in North China have been reversed. Since the turn of the century the northern ports, notably Dairen, Tientsin, and Harbin, have grown in importance owing to the increase in the production of cotton and soybeans and the development of railway transport. The shift of position of the various ports is shown in the following table of average yearly trade (in million tons).

1871–1880	Shanghai 87.49	Canton 17.29	Foochow 13.60	Amoy 8.24	Swatow 8.13	Hankow 5.84	Tientsin 3.74
1921–1929	Shanghai 786.58	Dairen 236.97	Tientsin 154.78	Canton 122.59	Hankow 65.67	Harbin 62.26	Kowloon 52.94

It is to be regretted, however, that Professor Wang failed to make use of his excellent material for a discussion of the dynamic relation between the physical and human aspects of geography.

The second number of the *Journal* has two articles on the geography of the Burmo-Yunnanese northern frontier that deserve special mention. Most of the popularly

used maps represent this frontier by an arbitrary line between China and Burma. The truth of the matter is that the border line has never been determined, and the so-called frontier, which is still a bone of contention between China and the British authorities, is about 30,000 square miles of wild and sparsely populated territory in northwestern Yunnan, southern Sikang, and northeastern Burma, between latitudes 25° and 28° N. and longitudes 97° and 99° E. Drawing his material from a wide variety of Chinese and British sources, Mr. Lin Chao gives a carefully considered historical sketch of the diplomatic controversy and an able summary of the geographical features of the region. The second article on the same subject is a short but valuable communication by a field investigator on the wild tribes inhabiting the area. The peculiarly mixed population and the fact that their characteristics are very little known to the outside world enhance the interest of this material to both the geographer and the anthropologist.

CH'AO-TING CHI

Some Recent Climbs in High Asia. Mountaineering and exploration of the high mountains of the Himalayas proceeded at a comparatively rapid pace during the season of 1934. At a number of places in the system high peaks were attacked with varying success. A résumé of several of these expeditions is given by Marcel Kurz in the November, 1934, number of *Die Alpen* (pp. 427–436). He also lists six expeditions that are proposed for the season of 1935.

The German expedition to Nanga Parbat in 1934 was a second attempt to conquer this 26,660-foot summit. On the first expedition, in 1932, difficulties with porters so slowed up the climbers that the weather broke before they could reach the summit. The chronicle of the 1932 expedition and an excellent description of the mountain and the problems this isolated peak presents to mountaineers were given in "The Naked Mountain" by Elizabeth Knowlton, official journalist, who accompanied the climbers up as far as 20,800 feet. The climbers' report was by the leader, Willy Merkl (*Zeitschr. Deutschen und Österreichischen Alpenvereins*, Vol. 64, 1933, pp. 59–74). The 1934 expedition was again under the leadership of Merkl. This time the climbers reached a height of about 25,600 feet. With only a thousand feet between them and the summit, they were overtaken by very bad weather that cost the lives of Merkl and two of his companions and of six native porters. A preliminary report of the expedition and some of the geodetic, topographic, and geologic findings are published in the January, 1935, number of *Petermanns Mitteilungen* (pp. 1–6). Fritz Bechtold, acting leader after the death of Merkl, has written an account of the expedition in "Deutsche am Nanga Parbat: Der Angriff" (1934). A series of reports and a preliminary stereophotogrammetric map appear in the *Himalayan Journal* (Vol. 7, 1935). Findings of the scientists of the expedition are presented in "Forschung am Nanga Parbat: Deutsche Himalaya-Expedition 1934" (Geogr. Gesell., Hannover, 1935). R. Finsterwalder contributes the geodetic-topographic section, W. Raechel the geographical, and P. Misch the geological.

Somewhat farther to the east, in the Karakoram Range, the International Himalayan Expedition under Günter Dyhrenfurth of Zurich concentrated on the high peaks at the head of the Baltoro Glacier. Members of the expedition climbed the east peak of the Golden Throne (24,000 feet) and all four of the "Queen Mary" peaks (highest, 24,350 feet). Madame Dyhrenfurth's ascent of one of these peaks credits her with the altitude record for her sex. A general report of this expedition is presented by Professor Dyhrenfurth in the March, 1935, number of *Die Alpen* (pp. 81–92). André Roch gives the details of the actual climbs in the February (pp. 67–80) and March (pp. 107–112) numbers of the same journal.

Still farther to the east Eric Shipton, H. W. Tilman, and three Sherpa were probably the first human beings to penetrate into the basin that surrounds the great mountain of Nanda Devi. Mr. Shipton says of this famous peak, the highest in British India: "The country we were now in is an extraordinary freak of nature.

and is, to the best of my knowledge, unique. As I have said, it is enclosed by a gigantic rampart of scores of peaks between 20,000 and 23,000 feet in height. The only breach in this amphitheatre is the gorge [Rishi] we had just come up. In the centre of the basin rises one of the most colossal masses of rock in the world, the majestic peak of Nanda Devi, whose sides are so exceedingly steep that even the plastic Himalayan ice can find little room to cling." The monsoon broke while the climbers were exploring the northern section of the basin. They retreated down the Rishi Gorge and spent some time exploring the Badrinath Range, whence come the three sacred headstreams of the Ganges. After the monsoon they returned to the south basin of Nanda Devi and climbed the mountain to an elevation of 20,500 feet. Mr. Shipton's report of this expedition is given in the April, 1935, number of the *Geographical Journal* (pp. 305–322); Mr. Tilman contributes a report to the volume of the *Himalayan Journal* for 1935 (pp. 1–26).

The assaults on Mount Everest continue. There were two in 1933. One of these, the Houston-Mount Everest Expedition, was successful in its attempt to fly over the mountain. The dramatic story of the flight is told by Air-Commodore P. F. M. Fellowes and his companions in the beautifully illustrated volume "First Over Everest!" (1934). The work of plotting the vertical photographs of the second flight is described by Lieutenant J. S. A. Salt in the *Geographical Journal* for February, 1934 (pp. 101–118). We now have Hugh Ruttledge's "Attack on Everest" (1935), beautifully illustrated also and an excellent account of the 1933 Mount Everest Climbing Expedition, of which he was the leader. This expedition was unsuccessful owing to bad weather and the early arrival of the monsoon, which turned two parties back at 28,000 feet.

The mountaineering expeditions to the high Himalayas have climbed without the use of oxygen. Slow acclimatization has been the method. On Nanga Parbat in 1932 altitude troubles were not the major difficulty. On Mount Everest, where acclimatization was given particular attention, F. S. Smythe spent three nights at an elevation of 27,400 feet, sleeping 13 hours on the third night. In discussing the growth of knowledge about acclimatization, Brigadier E. F. Norton recalled that on the 1922 expedition to Everest he made a special trip to see whether it was possible for human beings to exist without oxygen at 25,000 feet. The mechanism and effects of adaptation and acclimatization of man and animals to life at high altitudes constitute an important and little known field of knowledge. A group of scientists from the universities of Harvard and Cambridge is undertaking a study of this in the Andes during the summer of 1935.

Among recently published accounts of mountaineering in High Asia is the story of the Sikong Expedition to Minya Konka in 1932. This is told in "Men Against the Clouds" (1935) by Richard L. Burdsall and Arthur B. Emmons, 3rd. A map of the region and a discussion of the determined altitude of the mountain appeared in the *Geographical Review* for January, 1934 (pp. 118–128). "Men Against the Clouds" describes the approach and setting as well as the climb and tells how the expedition assembled a collection of rare specimens of big game. It furnishes an excellent description of travel in a little known region. The name for the mountain, it may be noted, is discussed in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* for December, 1934 (pp. 375–377).

MARGARET WARTHIN

The Geomorphology of Borderland Dzhungaria. The region between the Tien-Shan and the Great Altai is occupied by a confusing array of mountain ranges, plateaus, and hill country with associated lowlands. It has long been a much mooted question whether this Chinese-Russian borderland should be assigned to the system of the Tien-Shan or to that of the Great Altai. It was on the inspiration of Eduard Suess, the father of comparative geology, that V. A. Obruchev undertook his three summer expeditions of 1905, 1906, and 1909 into that hitherto neglected transitional

region, for which he coined the convenient term "Borderland Dzhungaria." In the first book of the third volume of "Borderland Dzhungaria" (Academy of Sciences of U. S. S. R., Leningrad, 1932) Obruchev deals in great detail with the orography and hydrography of this region, besides giving an exhaustive bibliography on the subject.

The highly complex structure is reduced to a relatively simple plan and is easily understood when presented in the light of its geologic past. A late-Paleozoic system of generally east-west folds became peneplaned during Permian and Triassic time. Radial stresses in the early Jurassic resulted in intensive block faulting. While the lower blocks were buried, the horsts, after continued peneplation, were newly elevated at the end of the Cretaceous. This second period of differential faulting along radial lines created high elongated blocks and numerous fault scarps. The loftiest ranges of alpine dissection, such as the Kertau and Katu, are etched out from higher wedge-shaped blocks, whereas the broader highlands and plateaus standing at intermediate levels can clearly be associated with the larger block systems and their characteristic fault scarps. The intermediate plateaus of the Maili and Dzhair are representatives of this category. The lowest blocks are in late maturity and have changed to monotonous hill country which carries a veritable labyrinth of small valleys and depressions of frankly desert character.

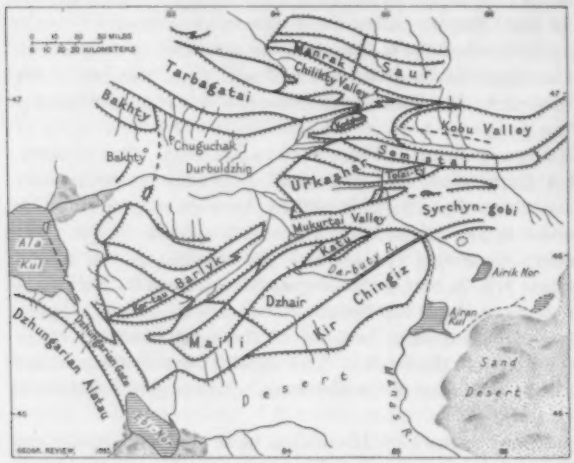

FIG. 1—Tectonic map of borderland Dzhungaria after V. A. Obruchev. Scale approximately 1 : 5,000,000.

Although block faulting is the tectonic key to the architecture of mountain ranges and highlands, giving sufficient clues to their striking variation in altitude, extent, and trend, the arrangement of the associated lowlands does not permit of an equally simple analysis. Great irregularity characterizes their pattern. Recent alluvium piled up in fans at the foot of the highlands often tends to obliterate the true graben character. The most conspicuous graben is the "Dzhungarian Gate," the natural gateway to China. Other lowlands, like that occupied by the broad shallow valley of the Emil, lack the characteristic graben structure. The absence of the likewise characteristic Angara (Jurassic) sediments points to later subsidence and to continental or lacustrine deposition, probably during late Tertiary.

Deep erosional valleys and gorges connect these lowlands with the mountains. Other valleys follow tectonic lines. This is especially true of many upper courses such as that of the Darbuty. The general drainage is radial in pattern, supporting the theory of radial faulting. Most of the rivers are intermittent; only a few, such as the Emil in the west and the Manas in the south, succeed in traversing their desert plains.

In summarizing, Obruchev contends that the entire Borderland Dzhungaria, from an orographic as well as from a tectonic point of view, belongs to the Tien-Shan. The tectonic boundary line between this system and that of the Altai lies to the

north of Borderland Dzhungaria, along the depression of Lake Zaisan and the valley of the Black Irtish.

Many other illuminating geomorphological details, as well as interesting general geographic notes, accompanied by twenty well selected illustrations, fill the 311 pages of Obruchev's masterly report and form a most valuable contribution to the geomorphology and general geography of inner Asia.

H. A. BAUER

The Iraq-Mediterranean Pipe Lines. Last January ceremonies were held to celebrate the completion of two pipe lines extending from the Iraq oil fields to the Mediterranean. The lines start at Kirkuk, east of the Tigris and some 150 miles north of Baghdad. Thence they run parallel and close to one another for a distance of 156 miles to Haditha on the Euphrates. Here they separate; one line leads southwestward through areas within the British sphere of influence—western Iraq, Trans-Jordan, and Palestine—to Haifa, and the other leads westward through areas under French control to Tripoli, passing en route within two miles of the ruins of Palmyra. Altogether there are 1150 miles of 12-inch pipe. "The weight of the pipe required was 120,000 tons—approximately 100 tons a mile."

The building of these pipe lines has been a remarkable feat of engineering and organization. For most of the way they run through desert country. There was occasional danger from attack by Bedouins, though on the whole the builders "enjoyed the good will of the public, in villages and desert tribes alike." The southern line crosses seventy miles of "lava country," where "the surface of the ground is covered with basaltic rock which in some places takes the form of a solid sheet and in others—the greater part—exists as boulders varying from 6 inches to 1 yard in diameter." A metaled road had to be built over this tract, where passage "was extremely difficult at all times owing to the blinding and suffocating dust which rose around each vehicle." The largest number of employees at work on the project at any one time was 14,364. These were recruited from many nations. The highly specialized task of welding was performed by Americans and by English welders under American instruction. Unskilled labor was furnished by the local population, who have learned thereby "something of sanitation and personal hygiene, and have been taught that the traditional customs of their tribes are not the rules which guide the rest of mankind." The construction of the pipe lines and some of the geographical obstacles that were overcome are described in a paper on "Middle East Geography in Relation to Petroleum" by Sir John Cadman, chairman of the Iraq Petroleum Company (*Geogr. Journ.*, Vol. 84, 1934, pp. 201–214), and also in *The Near East and India* (Vol. 44, 1935, pp. 68–72).

The Iraq Petroleum Company, which built and operates the lines, was organized in 1929. American interests, the Anglo-Persian Oil Company, the Royal Dutch-Shell, and French groups each control a 23¾ per cent interest in this company. The historical background of the enterprise is sketched and speculations concerning its international aspects are presented by Alfred Marcus in a recent article entitled "Oel im Osten" (*Tijdschr. voor Econ. Geogr.*, Vol. 25, 1934, pp. 45–51). In the event of a future war the pipe lines would be of the utmost strategic importance to Great Britain and France, since they would provide a direct fuel supply for the Mediterranean fleets of those nations over routes not exposed to the menace of hostile submarines. Presumably for similar reasons Italy is interested in a proposed third pipe line to run from Mosul by way of Aleppo to Alexandretta. Twelve pumping stations are distributed at distances of 55 to 95 miles along the two existing lines. Marcus asserts that these are in the nature of forts, intended not only to protect the pipes from native tribes but also, perhaps, to serve as defensive positions against a possible southward movement of the Russians toward the Suez Canal and Britain's lines of communication with the Far East.

POLAR REGIONS

New Longitude Determinations in Greenland and Jan Mayen in Relation to Continental Drift. A crucial test of the Wegener hypothesis of drifting continents is the comparison of longitude measurements at any one place over a long enough period of time. Two such series of measurements are now available, one for Sabine Island, East Greenland, the other for Jan Mayen. Sabine determined the longitude of the island that bears his name in 1823. It was again measured in 1870 by the astronomers of the *Germania* expedition and in 1907 by a Danish expedition under J. P. Koch. Comparison of the positions thus obtained led Wegener to postulate a westerly drift of Greenland of about thirty meters a year.

In an attempt to settle the question the Norwegian government, at the request of Professor K. Wegener, the brother of Alfred Wegener (who, it will be remembered, lost his life on the Greenland ice cap in 1930), sent Hans S. Jelstrup to determine the longitude of Sabine Island with the aid of the latest instruments, by the most modern methods, and with the great advantage over previous workers of being able to use electrically controlled chronometers and radioed determinations of time. The results of Jelstrup's work have recently been published by the Norwegian Spitsbergen department (Détermination astronomique à Sabine-øya au Groenland oriental, *Skrifter om Svalbard og Ishavet No. 58*, Oslo, 1933).

Taking the *Germania* observations of 1870 as the most accurate of the older measurements, Jelstrup finds an apparent displacement of 615 meters to the west in the 62 years between 1870 and 1932, a drift of 10 meters a year. According to Jelstrup, the older observations are subject to a systematic error of at least ± 83 meters, his own to an error of ± 22½ meters; but it is probable, he thinks, that the real error, systematic and accidental, of the older measurements may amount to a few hundreds of meters. Nevertheless, after minute examination of the possible sources of error, Jelstrup is convinced that the positional difference obtained by him (615 meters) is much greater than the sum of all possible errors in the measurements.

Making all allowances for sources of error in his own and in the older observations, Jelstrup finds that a longitudinal difference of 250 meters in the position of Sabine Island between 1870 and 1932 must be ascribed to a real westerly displacement, in accordance with the Wegener hypothesis. A total of 250 meters in 62 years amounts to an annual drift of 13.2 feet, or a mile in 400 years. On this basis the writer of this note calculates that if the mean distance of East Greenland from northwestern Europe is estimated to be 1500 miles it has taken 600,000 years to effect the present separation of the two land masses. This figure is in approximate agreement with estimates of the date of the Glacial epoch, subsequent to which Wegener places the separation of Greenland from northwestern Europe.

Similar longitude observations have recently been made by Hanns Tollner in Jan Mayen (Astronomische Ortsbestimmungen auf Jan Mayen . . . : Ergebnisse der Österreichischen Polarjahr-Unternehmung 1932/33 auf Jan Mayen, 1, *Sitzungsber. Akad. der Wiss. in Wien, Math.-naturw. Klasse*, Sect. IIa, Vol. 143, 1934, pp. 87–97). The longitude of a point on this island was determined in 1883 by an Austrian expedition. It was redetermined on exactly the same site by Tollner during the work of Austrian participants in the International Polar Year investigations of 1932–1933. Comparison of the figures thus obtained reveals an apparent longitudinal shift of 2 minutes 7.19 seconds in 50 years, Jan Mayen apparently being 1270 meters farther west in 1933 than in 1883, or 1400 meters if certain corrections are applied to the 1883 measurements. Thus the apparent drift of Jan Mayen is in the same direction as that of Greenland, the annual movement being 84 feet, as compared with 34 feet for Sabine Island.

On account of the uncertainties and errors inherent in the method of lunar culminations that was used by the astronomers of the 1883 expedition Tollner concludes

that his results cannot, or at least should not, be used as evidence in favor of Wegener's hypothesis of continental drift, and he considers that the same objections apply to the East Greenland observations on which Jelstrup based his opinion in favor of the hypothesis. Tollner upholds the cautious attitude of many geologists, geographers, and astronomers in regard to the possibility of testing the Wegener hypothesis by successive longitude observations. Thus, Professor L. Becker, of the Chair of Astronomy in the University of Glasgow, in a personal communication writes: "We have been determining the longitude frequently here [i.e. Glasgow] of late years, . . . and although the greatest source of error has now been removed (since wireless time-signals are now available) the discrepancies are sometimes considerable, and this by using the most modern appliances. Our average longitude differs by 0.7 secs. from that determined in my predecessor's time by Greenwich and Glasgow observers. Both stations were connected by wire and registered on chronographs. If this difference were real, it would mean we had moved 450 feet farther west relative to Greenwich. There must be an error somewhere in the old observations, although I cannot trace it." Nevertheless Tollner states that if Jan Mayen drifts westward at the rate of about 2 meters a month, as the above result implies, it would be possible to detect such movement with complete certainty within a period of three months by using modern geodetic methods.

Notwithstanding his caution in regard to his own results, Tollner is of the opinion that the longitude determinations by Jensen at Kornok in Godthaab Fiord (Greenland) in 1922 and their repetition by Sabel and Jörgensen in 1927 establish an absolutely real difference of longitude and therefore a real displacement of Greenland, detectable within five years.

This emphatic opinion lends point to the suggestion of Dr. L. Hawkes (The Hypothesis of Continental Drift, *Nature*, Vol. 135, 1935, pp. 342–343) that the time has come for some international body to take up this problem with a view to (1) inquiring what stations, such as the great observatories, have been determined with enough accuracy to be of use; (2) considering what further stations shall be established; and (3) organizing periodic redeterminations every five or ten years in the future.

Jelstrup himself expresses the hope that it will be possible to repeat his observations in, say, 1942 to establish the fact of drift beyond all possible doubt (Sammenligning mellem eldre og nyere astronomiske stedsbestemmelser på Sabine-øya som prøvesten for Wegeners teori om kontinentaldrift, *Naturen*, Vol. 58, 1934, pp. 300–312). Dr. Hawkes says further: "The stations must be chosen with due regard to geological situation. To examine 'continental drift' we shall want them on the great 'shields'—especially on extensive 'crystalline massifs', the so-called 'stable blocks'. That large horizontal displacements have taken place in the 'mobile belts' of the crust is known and it would be valuable to have stations on such belts which show activity at the present day, for example, the East-Indian island arcs, so that the movements of the 'stable blocks' may be related to the crumplings of the 'mobile belts'. Such results cannot fail to throw light on the mechanism of mountain building, and there is good reason to believe that it will now be possible to raise the study of crustal movements to a science by obtaining quantitative data." G. W. TYRRELL

Reversing Waterfall on Baffin Island. Reversing waterfalls occur in tidal waterways that have certain tidal and hydrographic features. These include a considerable range of tide, a relatively wide and deep connection with the sea, a narrow and shallow gorge some distance upstream, and a wider and deeper basin beyond. Under these conditions the rapid rise of the tide from the sea builds up a head on the seaward side of the gorge and produces a waterfall in the upstream direction. Similarly, on the ebb the rapid fall of the water below the gorge causes a head to form on the upstream side of the gorge, the waterfall now being in the downstream direction.

The combination of features necessary to bring about a reversing waterfall makes it a phenomenon that occurs in but few places. A well known example in North America is that in St. John River in the province of New Brunswick, Canada. Recently the Canadian Hydrographic Service has brought to light the existence of a reversing waterfall in Barrier Inlet on the Baffin Island shore of Hudson Strait. As described in the *Sixty-Seventh Annual Report of the Department of Marine* (Ottawa, 1934), Barrier Inlet is a fiord-like arm that extends twelve miles inland, with deep water inside. At the entrance the fiord is about one and a half miles wide, but two miles upstream the channel contracts to half this width and is further constricted by a number of rocky islets. The tide at the mouth of the inlet has a range of about 30 feet, and at the time of low tide on October 1, 1933, there was a sheer outward waterfall 8½ feet in height. When the rising water outside reached the same level as the falling water in the gorge, there was a slack for a few minutes, after which the inward rush of the water formed whirlpools and great eddies, and soon "waves, 6 feet high, careened wildly from side to side. A boat attempting to pass through at such time would be engulfed."

H. A. MARMER

PHYSICAL GEOGRAPHY

Internal Tide Waves in the Mediterranean. In a paper entitled "Sur l'existence de la marée sous-marine dans la Méditerranée occidentale" (*Bull. Inst. Océanogr. No. 656*, 1934) F. M. Navarro discusses the problem of internal tide waves as revealed by recent temperature observations in the western Mediterranean. These observations were made by means of a self-registering thermograph that gave a continuous record of the temperature of the water at a depth of about 32 meters. Daily fluctuations in temperature of more than a degree centigrade were found to have occurred at that depth. Furthermore, these fluctuations give evidence of periods of a lunar day and half a lunar day, i.e. periods partaking of tidal periodicities.

Such internal tide waves, manifesting themselves in periodic changes of temperature or density within the depths of the sea, have come to notice only in recent years, and more especially in the work of Otto Pettersson, who explains them as arising from variations in the vertical component of the tide-producing forces (La marée interne, *in* James Johnstone Memorial Volume, Liverpool, 1934, pp. 294–309). But this explanation is not accepted by leading oceanographers (see, for example, Albert Defant: Gedanken über interne Gezeitenwellen, *ibid.*, pp. 310–315).

Navarro further discusses the fluctuations in the monthly temperatures of the water at two other stations in the Mediterranean and directs attention to the fact that within the depths of this sea the fluctuations in temperature are of greater magnitude than at the surface—again an indication of internal waves. This phenomenon thus poses a number of unsolved problems in oceanography. And, as Navarro points out, it must be taken into account in the correlation of individual observations made at a given depth at different times.

H. A. MARMER

Threatening Glaciers. Under a happily chosen title, "The Study of Threatening Glaciers" (*Geogr. Journ.*, Vol. 85, 1935, pp. 24–41), Kenneth Mason describes several glaciers in the Karakoram whose movement has been sudden, unexpected, or, as he puts it, "accidental" (see also *Himalayan Journ.*, Vols. 1, 2, 4, and 5, 1929–1933). Some of these glaciers, notably those of the upper Shyok, have been in the habit of advancing rapidly and remaining in an extended position for a period of years. Where they have advanced across stream valleys, disastrous floods have been caused by bursting of the ice dams; in other places, in contrast with the hazard of too much water, irrigation channels have been deprived of their usual supply of glacial water, and previously cultivated fields have been left dry and unproductive. Some thirty

years ago the Yengutz Har, "perhaps the most exciting" glacier of the Nagar and Hunza region, advanced about three miles in eight days and put the irrigating system out of service for several years.

There seems to be no coördination in the movement of these glaciers; while one is advancing rapidly its neighbor may be gradually retreating. Advance appears to be controlled, not by climatic or weather cycles, but by local topographic factors. Apparently the tendency to move forward after the first rapid advance, once the glacier has dammed a stream, permits it to "heal" during the winter and allow a succession of blocks and floods.

Recurrent floods on the Talsekwe River, British Columbia, have been found recently to originate in an ice-dammed lake marginal to the Talsekwe Glacier. Their nearly annual appearance has been explained, however, not by a process of "healing" due to movement of the glacier, but by the accumulation of bergs and debris swept into the subglacial tunnel through which the waters escape (F. A. Kerr: The Ice Dam and Floods of the Talsekwe, British Columbia, *Geogr. Rev.*, Vol. 24, 1934, pp. 643–645).

In the Rio Plomo region in the Andes, where local conditions resemble those of the Karakoram, we find a striking similarity in the local behavior of glaciers (Robert Helbling: The Origin of the Rio Plomo Ice-Dam, *Geogr. Journ.*, Vol. 85, 1935, pp. 41–49). The Nevado Glacier, which in 1910 was retreating while one of its neighbors was advancing, recently pushed across the Rio Plomo, damming it and setting the stage for the disastrous flood of January, 1934. The ice movement was attributed by Helbling to overthrusting from the névé and from tributary glaciers below the névé line and was apparently independent of climatic or weather cycles.

Mason, in commenting on the paper by Helbling, states that he does not believe that tributary glaciers below the névé affected the movement of the Karakoram glacier. He agrees that the movement began in the uppermost, overloaded névé and that once past the degenerate snout it proceeded as "successive ice waves moving forward on successive shear planes roughly parallel to the bed."

Record of recent drainage of ice-dammed lakes in a previously unexplored valley in East Greenland has been found (J Harlen Bretz: Physiographic Studies in East Greenland, *in* The Fiord Region of East Greenland, by L. A. Boyd, *Amer. Geogr. Soc. Special Publ. No. 18*, 1935, pp. 159–245). Apparently the glaciers tributary to the main, ice-free valley have been subject to advance independently of one another in the recent past. This is suggestive of yet another case of "accidental" movement, unrelated to cyclic change.

HUMAN GEOGRAPHY

Some Geographical Aspects of Tourism. Improvements in transportation and the advance of "civilization" into remote regions are bringing tourists to places where they were never seen a few years ago. Ocean liners on tourist cruises have stopped at Spitsbergen, at Tierra del Fuego, and even at the lonely Tristan da Cunha in the South Atlantic. Tourism is developing in many unexpected areas; for example, New Caledonia, Uganda, the interior of Morocco, the mountains of Algeria, the Italian colonies, and even the heart of the Sahara (Le tourisme en Nouvelle-Calédonie, *L'Océanie Française*, Vol. 30, 1934, pp. 71–74; L. D. Galton-Fenzi: Uganda and Lake Kivu, brochure published by the Royal East African Automobile Association; M. de Mazières: Mouvement des voyageurs et des touristes au Maroc en 1933, *Rev. de Géogr. Marocaine*, Vol. 18, 1934, pp. 35–44; M. Bugeja: Le tourisme en Kabylie, *Bull. Soc. de Géogr. d'Alger et de l'Afrique du Nord*, Vol. 38, 1933, pp. 108–149; Carlo Della Valle: L'opera del Touring Club Italiano per le nostre colonie dal 1911 in poi, *Riv. delle Colonie*, Vol. 9, 1935, pp. 154–160). It is said that any make of car in good condition and provided with strong springs and an adequate repair kit can cross the

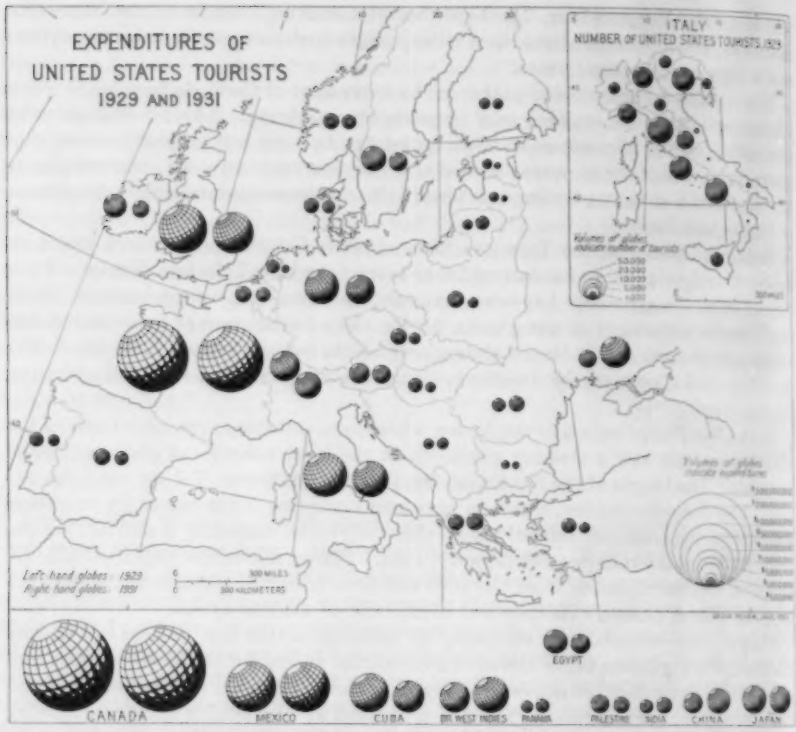

FIG. 1—Expenditures of United States tourists in Europe and other regions, 1929 and 1931 (based on table in F. W. Ogilvie: The Tourist Movement, 1933, p. 218), with inset showing number of United States tourists in Italy, by provinces, 1929 (based on statistics in Ente Nazionale Industrie Turistiche: Statistica del movimento turistico in Italia, 1929, Rome, 1931).

Sahara along routes southward from Algeria. Filling stations are located at close enough intervals to make it unnecessary to carry more than fifteen liters of oil and fifty liters of gasoline (Guide du tourisme automobile et aérien au Sahara, saison 1934–1935, Société Anonyme Française des Pétroles Shell, Algiers).

"The tourist movement . . . has assumed such dimensions in the last decade that the great moving markets of tourists are now an important factor in many of the balances of payments in international trade, and the livelihood of whole towns and districts in many countries" (F. W. Ogilvie: The Tourist Movement: An Economic Study, London, 1933, p. vii). In Italy the study of tourism has attained the dignity of academic recognition; a chair devoted to the economics of the subject has been founded at the University of Rome. In the United States the use of land for recreation (including tourism) is regarded as an important field of investigation (see *Geogr. Rev.*, Vol. 24, 1934, pp. 658–659). Possibilities of research in the economic geography of tourism are suggested in Professor R. M. Brown's paper elsewhere in this number of the *Review*. The lack, in this country as well as elsewhere, of detailed comparable statistics of tourism for small territorial units makes it difficult to analyze the tourist movement with any geographical precision. Italy and Czechoslovakia, however, have begun the compilation of statistics of this kind (see *Geogr. Rev.*, Vol. 18, 1928, pp. 504–505; Tourisme dans la République Tchécoslovaque en 1933, *Rapports de l'Office de Statistique de la République Tchécoslovaque*, Vol. 15, No. 34, 1934; and Sion's paper referred to below). The accompanying cartograms give some idea of the distribution of American tourist activities in Europe and Italy, but even rough

cartographic representations like these are seldom, if ever, found in the existing "literature" of tourism.

Further studies might well be made of what could be called the dynamics of tourism—of the forces that lead to the development of touristic activities of varying intensities and qualities in different regions and of the changing flow of tourists through established centers. According to Jules Sion, statistics of the annual and secular changes in the flow of tourists through Italy provide an accurate barometer of economic conditions in the many nations that contribute to this movement. Among the forces that bring about the development of tourism in different regions, the enterprise of chambers of commerce, hotel associations, railways, and the like is often as powerful as intrinsic natural and cultural attractions. Could large-scale maps of "densities of tourism" be prepared, they would probably show that few accessible localities having any intrinsic touristic attractions are not visited by tourists at some time during the year. Tourism abhors a vacuum—the mere fact that a locality of touristic appeal is not frequented makes it more attractive to discriminating tourists. These pioneers go to such places, which presently become widely known as being "unspoiled by tourists" and because of this may come to attract more tourists than other localities that enjoy no such reputation. This may account for the sudden and rapid growth of new resorts in unlooked-for spots; perhaps it explains in some degree the phenomenal development of tourism in the Balearic Islands in recent years (see Joseph Vassal: Le mouvement touristique des Iles Baléares, *Terre, Air, Mer: La Géographie*, Vol. 60, 1933, pp. 67–71).

Most tourists, however, keep to the beaten paths. Whereas Florence, Venice, the Riviera, and Rome are crowded season after season, other Italian localities of great beauty and historical interest are visited by only a handful of the elite. "For every thousand visitors to Florence, only seventy-one make the journey of two hours and twenty minutes thence to Siena. For every thousand foreigners who enter St. Mark's, only fifteen deem it worth their while to see Ravenna." The exquisite medieval towered hill town of San Gimignano in Tuscany welcomed only 247 foreign tourists in a year (J. Sion: Tourisme, économie, psychologie: les étrangers en Italie, *Annales d'Hist. Écon. et Soc.*, Vol. 4, 1932, pp. 529–537).

Among the most active organizations for the promotion of tourism in Europe are the Swedish and the Italian touring clubs (see *Geogr. Rev.*, Vol. 13, 1923, pp. 608–612; Vol. 18, 1928, p. 505). Both publish guidebooks and maps of high quality. The yearbook of the Swedish Touring Club (*Svenska Turistföreningens Årsskrift*) contains popular descriptions of different parts of Sweden illustrated with excellent photographs in half tone and in color. Mention should also be made of the extraordinary "Manuale del Turismo" of the Italian Touring Club (Milan, 1934). This is not a guidebook of the Baedeker type but a tourist's "World Almanac," packed with closely printed information concerning nearly everything that could conceivably be of interest or practical value to Italian tourists and foreign tourists in Italy. The book is divided into sections on pedestrian tourism (including Alpinism, skiing, hunting, and fishing), railway tourism, highway tourism (the roads of Italy, automobilism, motorcycling, and bicycling), nautical tourism, aerial tourism, subterranean tourism (excursions in caverns), and legal aspects of tourism.

The Wends in Germany and in Texas. In Upper and Lower Lusatia, within about fifty miles of the southeastern outskirts of Berlin, lies the edge of an ethnic island of some 100,000 Slavs. These folk, who speak a language closely akin both to Czech and to Polish, call themselves "Serby" but are more generally known as Wends. In the Middle Ages they occupied a wide territory in north-central Germany. The Germans, however, have steadily advanced upon them, hemming them in on all sides in such a way that the area in which Wendish is spoken now measures scarcely more

than sixty miles from north to south and considerably less from east to west. Today the two principal towns in the Wendish territory, Bautzen and Kottbus, are overwhelmingly German. The Wends are the subject of a recent study by Professor G. C. Engerrand of the University of Texas (The So-Called Wends of Germany and Their Colonies in Texas and in Australia, *Univ. of Texas Bull. No. 3417*, 1934).

The folklore of the Wends is extremely rich, "possibly because their late acceptance of Christianity has better preserved its many aspects." They have also produced a literature that is surprisingly abundant considering their small numbers and rural characteristics. It is said that "1,030 Lusatian songs have been gathered, which is one for every 150 inhabitants, a figure that is not reached by any other country, the next one supposed to have a wealth of songs, Poland, having only one for every thousand inhabitants." Poetry and art are also well developed. On the basis of their distinctive culture, movements for independence, or at least for autonomy, were vigorously promoted by Wendish leaders at the close of the World War.

In 1854 a group of some five hundred Wends, devout Lutherans, migrated to Texas in search of religious liberty. They purchased a tract of land in what is now Lee County in a timbered country of poor sandy and clayey soils (E. H. Johnson: The Natural Regions of Texas, *Univ. of Texas Bull. No. 3113*, 1931, p. 111). From this center, to which they gave the name of Serbin, other colonies were established in different parts of the state, and after prolonged hardships a moderate degree of prosperity was attained. There are now believed to be some seven thousand persons of Wendish origin in Texas, and 90 per cent of these are farm dwellers.

Surrounded by such a totally different environment these folk have lost many of their distinctive characteristics. In the wooded, lake-strewn, glaciated lowlands of Lusatia "country and men have become one in a true anthropogeographic way, as clearly expressed in the rich local poetry." In Texas the poetic and literary gift seems to have been lost. The use of the Wendish language is rapidly disappearing, but instead of being directly replaced by English it has given way for the most part to German. The Texan Wends have thrown in their lot with the large German Lutheran population of the state, with whom they have intermarried and from whom today they are almost indistinguishable. "Germanization appears to be an essential stage of his [the Wend's] final Americanization." All ties with the Wendish homeland have been severed.

There is a considerable Wendish population in Australia. The migration began about 1847 but, unlike the movement in Texas, was primarily for economic betterment rather than in quest of religious liberty.

Iron, Prehistoric and Ancient. That the Hallstatt civilization, as revealed by excavation of its cemetery, is the first absolute evidence of a going iron industry is the argument presented by H. C. Richardson in the *American Journal of Archaeology* (Iron, Prehistoric and Ancient, Vol. 38, 1934, pp. 555–583). Mr. Richardson believes that "there is no warrant in fact for Assyrian iron until the eighth century B.C." and "there is no valid authority for iron among the Egyptians before the Assyrian conquest." Quite soundly, he points out that the text of the much cited letter from Hattusil III to Ramses II does not prove that the Hittites themselves were makers of iron but that the statement "I have written to get iron" indicates rather that they obtained it from others. A full-page plate shows ancient centers of iron industry and the main trade routes. Mr. Richardson suggests that the use of iron was forced on Asia by conquering invaders from Europe. He thinks that the working of iron in the Danube Valley did not begin before 1500 B.C. The thesis that the working of iron first began there therefore involves the rejection of claims of an earlier date for iron specimens found in other regions. For the reasons he advances to support this view reference should be made to the original paper.

THOMAS T. READ

Two Fundamental Geographical Inventions. The invention of a map projection universally used by geographers and sailors has made the name of Gerhard Mercator known to every educated person. To Mercator's teacher, Gemma Frisius (1508–1555), belongs the credit for two inventions of far more fundamental value—yet, by the irony of fate, few but specialists in the history of geography are familiar with Gemma's name.

When a young man of only twenty-one, Gemma, who later became a professor of medicine at Louvain, published a book entitled "De principiis astronomiae" (1530). In a short chapter in this work the epoch-making suggestion is made that clocks or watches, when carried from one place to another and not allowed to run down, may be used for the determination of longitudes. "The invention of the fusée, about 1525, improved portable timepieces to such an extent that they became capable of a more or less uniform 'continuus motus' during 24 hours—even of a 'perpetuus motus,' if wound up in time." Gemma's other great invention was that of the method of triangulation as a basis for topographical surveying. To a second edition of Peter Apian's "Cosmographicus liber" edited by Gemma and published in 1533 he appended a "Libellus de locorum describendorum ratione," in which this method is explained and exemplified. "The horizontal use of an astrolabe for the determination of azimuths of celestial bodies was centuries old; Gemma was the first to realize that by determining the bearings of terrestrial landmarks, and by repeating the observations at several stations, a network could be drawn on paper which would give, by the intersections of corresponding pointings, a map of the country surveyed."

The geographical importance of Gemma's work was made clear in a brief article by Dr. E. G. R. Taylor in 1927 (The Earliest Account of Triangulation, *Scottish Geogr. Mag.*, Vol. 43, 1927, pp. 341–345). The quotations in the preceding paragraph are from a recent and more comprehensive study by Dr. A. Pogo (Gemma Frisius, His Method of Determining Differences of Longitude by Transporting Timepieces (1530), and His Treatise on Triangulation (1533), *Isis*, Vol. 22, 1934–1935, pp. 469–506). Scholars are indebted to Dr. Pogo for a discussion of biographical and bibliographical problems concerning Gemma's work, a detailed analysis of the "Libellus," and a complete facsimile reproduction of the full text of the "Libellus" from a copy in the Library of Congress.

GEOGRAPHICAL REVIEWS

A Systematic Treatise on Africa

Walter Fitzgerald. **Africa: A Social, Economic and Political Geography of Its Major Regions.** xv and 462 pp.; maps, diagrs., bibliogrs., index. Methuen & Co., London, 1934. 16s. 9 x 6 inches.

The task of preparing a systematic work on the regional geography of Africa presents many difficulties, the greatest of which is the unequal quality of the original data for the various regions. It is perhaps mainly for this reason that no serious work on the subject has appeared in English since A. H. Keane's "Africa" was published in 1895. When we recall the great advances in knowledge of Africa as well as the rapid changes in the last four decades, due to European penetration, and remember the development in geographical method in the same period, we realize the extent to which an English treatise on the continent was overdue. Mr. Fitzgerald, therefore, has placed in his debt a very wide circle of those who for the first time will be able to obtain a comprehensive view of Africa as it is, presented in the form of a series of synthetic studies by a competent geographer.

The regional presentation occupies the main part of the book and, by its subdivision, demonstrates the difficulty of delimiting natural regions in a continent whose outstanding feature, south of the Sahara, is the gradual transition from type to type. Thus in the chapters on these areas the author deals with groups of political units; but he justifies this method, since his most valuable contribution is perhaps his comparative treatment of the relations between the native populations and the Europeans, and these differ widely in the various territories. Mr. Fitzgerald, starting from an intimate personal acquaintance with conditions in South Africa, has made a close study of the literature on the "native" policy of each of the other governments, and in his text he brings out clearly the contrasts between British, French, and Belgian and Portuguese methods, both in general and in the particular areas dealt with. He is a keen critic of all administration that has, in his view, been detrimental to native interests. For example, his statement concerning Kenya Colony is a heavy indictment of British policy. But, on the other hand, he is eloquent on the success of the British method of indirect rule wherever this is practiced. The Belgian variant of the method meets with less praise. In regard to the French policy of direct rule with assimilation and military service the author is evidently skeptical. He criticizes vigorously the French administration in Central Africa (A.E.F.), and he regards the former German system in Kamerun as more in keeping with the mandatory spirit than the system that has obtained since the mandate was set up. On the other hand, he regards as detrimental the old Arab *akida* system of government perpetuated by the Germans in Tanganyika and notes that the succeeding British method of reëstablishing the authority of the chiefs has been beneficial.

It must not be assumed that the attention given to these matters in a geographical work is excessive; for in all the regional chapters this aspect is related to the mode of life of the natives as affected by their environment and by the economic character of the European occupation, and both are presented as the sequel to good accounts of the physical background. Another feature of the work is the care that has been taken to give an up-to-date statement of economic progress, whether in European agriculture by colonization or plantations, by the development of mines and communications, or by the efforts to combat the prevailing diseases and pests. Here there seem to be few important omissions. Moreover, the author frequently ventures an opinion on probable future developments—a useful feature in relation to Africa.

These regional chapters are preceded by Part I: The Physical Environment and Part II: The People—Immigrant and Native. The author clearly had his heart in

Part II, which is very well done; Part I is less inspired, and it suffers, too, from the crudity of the maps. The ninety sketch maps and diagrams are another feature of the book, and it seems likely that they would have been less numerous but for the fact that the author drew most of them himself. It is doubtful, however, whether the publisher of a serious work is well advised in presenting geographers today with anything but the best cartography. Thus, although the reader is certainly the gainer through Mr. Fitzgerald's industry in preparing, for example, provisional population-density maps—rough though they are—for all the regions, he might have learned much more, for instance, from the geological map of Africa, had it been less crudely drawn. Yet it must be conceded that a great many of the maps appear for the first time in a textbook, and most readers will be grateful for them.

ALAN G. OGILVIE

AFRIKAANS AND THE AFRIKANDER

ADRIAAN J. BARNOUW. **Language and Race Problems in South Africa.** 71 pp. Martinus Nijhoff, The Hague, 1934. Gld. 1.20. 9½ x 6¼ inches.

This little volume, beautifully printed in a foreign land and written in charming English by a foreigner, tells a remarkable story. Afrikaans is the language of the Boers of South Africa, and it is *not* Dutch. The Afrikanders who speak it cannot read Dutch books without the same sort of study they would have to give to English or or any other foreign language. It has been very much simplified from the language of the Dutch settlers. It has additional Malay-Portuguese words from the slaves imported from the East Indies. Since the union all officials have to know not only English but the Taal (i.e. Afrikaans), even in districts of solid English speech. Admittedly the Taal is adequate only for the life and landscape of the veld. Its vocabulary is not broad enough to cover life on wider horizons or with universal interests. But it borrowed words for these purposes oftener from English than from Dutch. The mass of the Afrikanders do not read anything but the Bible. The exceptional folks who do want to know what is going on beyond the veld read books in English, as library records attest everywhere. The Bloemfontein public library, for instance, in 1928 issued 77,107 English books, 217 in Dutch, and 275 in Afrikaans.

The Afrikanders care nothing today for Holland. The defunct Boer states—Transvaal and Orange Free State—made Holland Dutch official and the language of the schools. Afrikaans was then not used in print. Holland Dutch is theoretically still on a par with Afrikaans, "but it is a distinction that means nothing in practice. Afrikaans, the country's own brand of Dutch, has taken its place and has amply proved that its succession to the rights of the parent language was beneficial to the common weal."

As everyone knows, the Boers are in general opposition to the English and outnumber them. They are more and more taking their own way in the Union government, yet they have themselves, our author says, unwittingly become more English than Dutch. In conversation the Afrikander "practices a polite reticence that is thoroughly English, but entirely alien to Dutch custom and tradition. As a social animal the Afrikander belongs to the species called Briton. It is perhaps a subconscious awareness of this assimilation that makes the Afrikander so aggressively anti-British."

That is a remarkable revelation delicately expressed. If an Englishman had discovered the fact, he could not possibly have given it expression with the convincing authority of this Dutch gentleman and scholar. Dr. Barnouw was a most happy choice of the Carnegie Corporation to make a comparative study of the Afrikaans and Dutch languages. There will not fail to come to the mind of the intelligent reader the comparable and yet ever different cases of the French Canadians and the Pennsylvania "Dutch"—who are German.

Dr. Barnouw laments the Afrikander's lack of sympathy for the blacks who make up four-fifths of the population of the Union. He does not show that he is aware how great a part this callousness has played in the frictions between Briton and Boer. The admirable medical service of David Livingstone to the blacks and the intense opposition of the Boers to it come to mind as we read of their unwillingness to allow South African blacks to study medicine in the face of an immense need. But very likely he has preferred not to enter into the differences between the races.

The little book as far as it goes is the most enlightening volume about South Africa that has come to hand.

MARK JEFFERSON

THE POPULATION OF ABORIGINAL AMERICA NORTH OF MEXICO

A. L. KROEBER. **Native American Population.** Map. *Amer. Anthropologist*, Vol. 36 (N.S.), 1934, pp. 1–25.

This paper is an abstract of a large memoir, as yet unpublished. Professor Kroeber has divided the Indian tribes north of Mexico into 80 cultural groups, has readjusted for these groups James Mooney's estimates of the aboriginal population of this territory, and has calculated the density of the population for each group. He deduces that the population along the Pacific coast, from the Aleutian peninsula to Mexico, was far denser than the population of the eastern and central regions of the United States, although the Pacific-coast natives practiced no agriculture, whereas the eastern and central natives had grown corn, beans, and pumpkins for many centuries; that even the Arctic coast, taken in its entirety, supported a population denser than that of the immediate interior, half as dense, indeed, as that of the agricultural areas of the United States; and that "the population density in the farming parts of the Atlantic and Gulf region was perhaps twice as heavy on the coast, including habitats on tidewater or within a day's travel of salt water, as immediately inland thereof." He concludes that "coastal residence did make for heavier population; agriculture per se did not necessarily increase density." Furthermore, by estimating that an acre of corn yielding from 15 to 20 bushels, supplemented by a certain amount of fish, game, wild roots, and wild berries, would sustain one person for a whole year, he calculates that the eastern and Mississippi Indians cultivated less than one per cent of the area capable of giving them successful crops and that they could have survived and maintained their numbers even without any agriculture.

This relative insignificance of agriculture in the east he attributes to two principal causes, both of them social—interminable warfare, with its accompaniment of unrest and famines, and ineffectual political organization, which prevented the emergence of stable, internally peaceful states. He acknowledges that such states probably existed in mound-builder days, when the population seems to have been a little denser; but they crumbled before the arrival of Europeans, he suggests, because their system was of foreign (Mexican?) import and not truly rooted in the indigenous culture.

He finds one exception to these conclusions. The country of the Pueblo peoples in the Southwest boasted a population nearly four times as dense as that of any other agricultural region in the United States, although much of their land was desert or mountainous. Evidently they exploited far more intensively such cultivable land as they possessed; in fact, their whole economy was built on agriculture, whereas elsewhere agriculture "was an auxiliary, in a sense a luxury." He notes, in passing, that this difference in the significance of agriculture supports the current theory, based on differences in pottery, weaving, and methods of corn crushing, that maize did not spread from the Pueblo region eastward but reached the Mississippi basin and the eastern United States direct from Mexico or Central America, either along the coast or through the Antilles.

Such, in brief, are the high lights of Kroeber's arresting paper. It is difficult to discuss his figures and the conclusions he derives from them without studying in detail his 80 cultural areas, which he explains only in the larger memoir. It is clear, however, that the areas vary enormously in extent: three-fourths of the Arctic falls into one area, one-fourth of Canada into a second, part of Florida into a third, and the Gulf of Georgia into a fourth. If for any reason we should reject some of these cultural areas, if we should subdivide or combine any of them, the figures for density would change entirely and Kroeber's interpretations might have to be modified. Let us see what would happen in eastern and northern Canada, since the reviewer is more familiar with these regions than with those south of the international boundary.

Kroeber combines into one area Newfoundland, the Labrador peninsula (except most of its coast), and those parts of Ontario and Manitoba that were inhabited by the Cree. Into another area he combines the territories of the Algonkin and the Ojibwa. There seem to be no compelling reasons for these particular combinations. Culturally the Algonkin graded imperceptibly into the Montagnais of Labrador, and the Ojibwa into the Cree, while the Beothuk of Newfoundland had as much in common with the Nova Scotia Indians as with their neighbors in Labrador. In still a third area Kroeber unites the Athapaskan tribes of the Mackenzie River basin with those of the Yukon, although there are just as good grounds for separating them as for dividing the Eskimo area at Coronation Gulf. Revamping the unit areas to correspond more closely to the tribal divisions we obtain a table like this:

	AREA (SQ. MILES)	POPULATION	DENSITY PER 100 KM²
Newfoundland (Beothuk territory, which excludes the N. penin.) . .	38,000	500	.51
Most of Labrador Peninsula (Montagnais-Naskapi area)	380,000	5,500	.56
Northern parts Ontario and Manitoba (Cree area)	385,000	21,000	2.1
Mackenzie River basin (Athapaskan area)	850,000	11,430	.52
Nova Scotia and part of New Brunswick (Micmac area)	48,600	3,500	2.8
St. Maurice River to Lake Nipissing (Algonkin-Ottawa area)	64,000	6,000	3.6
Northern Great Lakes (Part of Ojibwa area)	136,000	31,300	8.8
Southeastern Ontario (area of Huron, Tobacco, and Neutral nations) . .	25,800	28,000	41.8

It is clear that the Mackenzie River basin, with less than a mile of coast line, supported a population as dense as that of Labrador or Newfoundland and that Newfoundland, with a coast line about equal to that of the Micmac in the Maritime Provinces, supported a population only one-sixth as dense. The inland Algonkin-Ottawa equaled the coastal Micmac in density, and the density of the Ojibwa was nearly three times as great, while the only agricultural peoples in Canada, the Iroquoian in southeastern Ontario, exceeded in population density every other people in the dominion. This suggests an important revision of Kroeber's interpretation. The significant factor seems to be not coast line but food resources, and not food resources alone but the knowledge and ability to profit by them. The Ojibwa population was denser than that of other Algonkian tribes because their territory was richer

in fish, game, and vegetable foods (notably wild rice and maple sugar); the Micmac far outstripped the Beothuk, partly because their resources were a little greater, but partly because they made greater use of them.

This relationship between food resources and population in nonagricultural regions becomes still clearer if we consider the Eskimo and the Aleut. Mooney's estimate of their numbers in pre-European days seems about 30 per cent too high, but even he agrees that formerly, as in historical times, nearly two-thirds of them lived in Alaska south of Bering Strait, within the area enriched by the Pacific-coast salmon, a food supply that was not only abundant and easily obtained but, what was even more important, absolutely certain from one year to another. Elsewhere throughout Arctic and sub-Arctic America the Eskimo settlements were scattered and discrete. Large tracts of coast line, indeed, ranked as "desert" and were wholly or practically uninhabited.

Kroeber's second thesis, that "agriculture per se did not necessarily increase density," seems also to call for some slight qualification, even though he limits its application to the Mississippi basin and the eastern United States. Let us consider four areas—southeastern Ontario, Wisconsin, the Ojibwa territory north of the Great Lakes, and the North Atlantic slope. The densities of their populations were respectively 41.6, 12.52 (Kroeber), 8.8, and 2.22 (Kroeber). The first was an agricultural region; in the second and third the Indians, doubtless through contact with agricultural tribes, consumed respectively greater and lesser quantities of wild rice; while on the North Atlantic slope they depended entirely on fishing and the chase. Since the resources in fish and game of the four regions were about alike, as far as we can judge, it is hard to see any cause except agriculture for the marked differences in population densities. Again, we may reasonably question whether any region in the United States east of the Rockies possessed greater resources in fish and game than the North Atlantic slope, so that the higher densities of population south of the New England states must surely be attributed to agriculture. Nevertheless, it still remains true that over large areas, despite the fertility of the soil, the density was extremely low, very much lower than in the arid Southwest or in Mexico; and we are indebted to Kroeber for giving prominence to this fact. The two causes that he advances, incessant wars and ineffectual political organization, may possibly afford a satisfactory explanation; but one wonders if there was not also a third cause, namely the conservative food habits of the Indians, which made them demand a very high proportion of meat and fish in their diet. It is well known, for example, that even today the Eskimos and Indians of northern Canada consider themselves starving unless their diet consists mainly of meat and fish; and the average half-breed has the same preference.

The reviewer is not qualified to discuss the final sections of Kroeber's paper. They present, without entering deeply into reasons, the author's estimates of the aboriginal population, first in Mexico and Central America, then in the entire hemisphere. His total, 8,400,000, is from 40 to 50 per cent lower than any previous estimate, but it can be challenged effectively only by a detailed study of America south of the Rio Grande, region by region, such as Mooney has made for the northern part of the hemisphere.

DIAMOND JENNESS

THE WATER PROBLEM OF SOUTHERN CALIFORNIA

ERNEST L. BOGART. **The Water Problem of Southern California.** 132 pp.; map, diagrs., index. *Illinois Studies in the Social Sciences*, Vol. 19, No. 4; *Univ. of Illinois Bull.*, Vol. 31, No. 43, 1934. $1.00. 10¾ x 7 inches.

An acute water problem has been created in the Los Angeles metropolitan area, where growing cities and intensive agriculture have made too heavy demands on the underground sources in recent years. The plain truth is that more water has been

taken out than could be replaced by normal recovery in the subsurface basins. The city of Pasadena has taken steps to obtain more water for an increasing population, and Long Beach, Anaheim, and Santa Ana have engaged in legal arguments over their respective riparian rights, but the greater number of the people and the city officials have failed to recognize the fact that a seriously lowered water table is the concern of everyone. State officials, it is true, have attempted to coördinate the numerous problems and to formulate a comprehensive plan for the future development of water storage and flood control throughout the state.

It is encouraging to find an author who considers the whole question as a single problem, not only as concerns water rights, but as regards the close relationship between the conservation of the water supply and the control of flood damage. It is, however, unfortunate that the sources consulted by Dr. Bogart represent almost exclusively the standard works on irrigation practice or the publications of various California commissions and the Division of Water Resources. The result is a too detached synthesis. We fail to see the problem from the viewpoint, say, of the citrus grower or the dairyman. To be truly effective, a study such as this should at least indicate the bitterness of attitude that the rancher openly displays toward a power company that makes excessive charges for the "juice" to operate his pumped wells. In other words, the evident lack of personal intimacy with the problem in the field detracts from the value of the publication. Although "the agricultural problem" forms the subject matter of one of the chapters, the attitude of the author is that of the college-trained agriculturist rather than of the vineyardist or the citrus grower who uses the water.

The geographer will find the discussion of the geographical and geological problems inadequate, especially in the section on the climate. The general reader will wish for a more extensive treatment of the importation of water supplies from the Owens River Valley and the Colorado River, but the subject is dismissed in a single short paragraph. It is in the chapters on the legal problem and the economic problem that Dr. Bogart's work is most satisfactory, especially in the former, with its conclusion that "the early *laissez-faire* policy with its minimum of responsibility and supervision is no longer feasible in a closely settled region such as southern California has become." This conclusion has a broader application than the author indicates; for it applies not only to the legal aspects of the problem but to the wastage of water, the question of riparian rights, investigations of the economic feasibility of further extension of irrigated lands, construction of flood-control works and aqueducts, and other allied problems.

H. F. RAUP

LAND USE IN MINNESOTA

Land Utilization in Minnesota: A State Program for the Cut-Over Lands. Final Report of the Committee on Land Utilization Appointed by Governor Floyd B. Olson, August 4, 1932. xiv and 289 pp.; maps, diagrs., bibliogr., index. The University of Minnesota Press, Minneapolis, 1934. $1.50. 9½ x 6½ inches.

OSCAR B. JESNESS, REYNOLDS I. NOWELL, AND ASSOCIATES. **A Program for Land Use in Northern Minnesota: A Type Study in Land Utilization.** xvi and 338 pp.; maps, diagrs., ills., index. The University of Minnesota Press, Minneapolis, 1935. $2.50. 9½ x 6½ inches.

Leaders in Minnesota have been compelled to realize that there is need for a drastic change in land policy. Until recently the policy has been to encourage private ownership and unregulated exploitation. If land could not be sold, it was given away. Tax-delinquent land was kept from reverting to state ownership by repeated extensions for the payment of delinquencies and by "bargain settlements" for a fraction of the taxes due. However, with half of the privately owned land in the northeast

quarter of the state tax delinquent, a huge per capita debt, heavy drains on the rest of the state for the support of schools, roads, courts, etc., and for relief, the situation has become acute. The hope that all parts of the state might be occupied by prosperous agricultural families has been blasted. The exhaustion of the timber, the decreased demand for agricultural products, the increased competition of more favored land, made possible by improved transportation, have united to make successful agricultural use of the poorer lands out of the question. The depression affected adversely the mines and industries of the state as well as the formerly successful farmers on the better lands and made more onerous the burden of helping the poverty-stricken people of the poorer counties.

The Governor appointed a committee, under the chairmanship of the president of the state university, in 1932, to make recommendations for land planning. Their report was published late in 1934. It gives an excellent picture of the sad consequences of past policies and discusses well the need for future planning, suggesting various reasonable programs and new legislation. It deals with the state as a whole but mentions repeatedly sixteen cutover counties (not specified). These counties are losing population if Duluth is excluded. Moreover, the iron mines, which support a considerable fraction of the people, are likely to be short-lived. The high-grade ore presumably will be exhausted by 1960.

In March, 1935, a second, independent volume, dealing with problems of land use in Minnesota, appeared. It represents the result of specific research in the northeastern counties. The fourteen least fortunate counties are discussed, and the suggested future use of the land is shown on fairly large-scale county maps. It is proposed that a large portion of the land in these counties be devoted to state and national forests; that other large areas not suitable at present for reforestation, because of the presence of swamps or the loss of soil by repeated burnings, be set aside for water storage; that localities adaptable to summer homes and recreation be reserved for these uses; and that agriculture or permanent residence be permitted only on the more favorable spots. Other recommendations are that many farmers be relocated on better and more advantageously situated land, that many schools be closed, and that many governmental units, especially the townships, be abolished. A close coördination of various governmental activities is also recommended, this to be done under the supervision of a State Board of Conservation.

STEPHEN S. VISHER

GERMAN-POLISH BORDERLANDS

HERBERT KNOTHE, edit. **Vom deutschen Osten: Max Friederichsen zum 60. Geburtstag.** xii and 427 pp.; maps, diagr., ills., bibliogrs. *Veröffentl. der Schlesischen Gesell. für Erdkunde E. V. und des Geogr. Instituts der Univ. Breslau, No. 21.* M. & H. Marcus, Breslau, 1934. 9¾ x 6½ inches.

For nearly thirty years Professor Friederichsen, teaching at Rostock, Greifswald, Königsberg, and Breslau, has been concerned in person and through his students with the study of eastern Germany. This is appropriately recognized in this *Festschrift* of twenty-seven papers contributed by friends, students, and colleagues.

A series of studies in cultural geography forms the bulk of the volume. It is well introduced by Schlenger's study of the relations between cultural geography and folklore (*Volkskunde*) as illustrated in eastern Germany. The recent development of cartographic studies of the distribution of dialects, customs, etc., though recognized as not in itself geographical, should supply the cultural geographer with valuable material. Particularly the concept of community (*Gemeinschaft*)—of religion, speech, settlement, etc.—provides the connecting element between folklore and cultural geography.

Schlenger bases his detailed discussion on the studies in course of preparation for

the "Atlas der deutschen Volkskunde." One group of topics shows the west-east direction of German cultural influences. Examples are found in the distribution of different types of windmills (Dutch mills in the lower-Vistula region); two-wheeled field wagons; the "house dragon" (a tradition of Slavic origin); the lantern procession of late summer; and the use of the term "Altjahrsabend" for December 31. Another group brings out north-south distinctions in the cultural characteristics of eastern Germany. These include: whether windows open out or in; the custom of halting the wedding procession at the church with chains or ribbons; the superstition of Monday as here a lucky, there an unlucky, day; and, of special interest to us, the use of the universal Germanic word "Korn" in some areas to refer to all grains, in most of eastern Germany to mean only rye, and only in Transylvania to mean wheat. Differences between other regions are found in the word "Schmand" as used for the fat part of sweet milk, which marks the area of the Teutonic Order; types of cradles; the stressing of the "name day" rather than the birthday; and various words used regionally for certain purposes. Such materials, the author feels, can be used to enhance the concept of *Kulturlandschaft*. (The German word permits this, but it is obvious that the simple translation "cultural landscape" leads to misunderstanding here.)

Schlenger maintains that the forms of settlement—a feature that many of the other authors make much of—are independent of *Volk*. The student of these forms, however, will find valuable field discussion, well illustrated, of such individual forms as *Strassendorf*, *Reihendorf*, *Weilerdorf*, *Angerdorf*, and *Einzelhof* in Geisler's study of the lower-Vistula area and in Kretschmer's study of the *Ellguth* in Silesia. The student of historical geography, interested in the portrayal of the cultural landscape of past periods, will find much of value not only in these articles but also in the studies of the prehistoric geography of East Prussia and Silesia by Berninger, Raschke, and Geschwendt, and especially in Ouvrier's picture of the changes in the Middle Silesian plain between 1825 and 1925. Particularly interesting is the change in large areas of meadows and fallow land formerly used for sheep grazing but now almost completely cultivated—80 per cent in the black-soil area—in wheat, rye, sugar beets, etc.

Only one paper has to do specifically with political geography—Volz's very general treatment of the geopolitical nature of the Silesian "embayment." But through most of the studies in cultural geography runs a common thread of interest in the "national" character of the cultural landscapes of these debatable border regions.

Thus Mager, in his essentially historical study of Pommerellen, and Geisler, in his geographic study of village forms in the same area (the Corridor), agree that the Vistula lowlands and parts of the "diluvial plateau" were settled solely by Germans (including Dutch); cultivation with the hoe or with weak draft animals prevented the earlier Slavic peoples from using these heavy clay and loam soils. Geisler (see above), disagreeing with the Polish geographer Zaborski, finds that no settlements of Poles migrated from the middle Vistula (Congress Poland) toward the sea; the Kashubes were therefore isolated from the Poles proper by a belt of German settlement across the southern part of the Corridor and northern Posen.

In Silesia Raschke found that the German settlements of the thirteenth century did not use—except for fortresses—the sites formerly favored by the Poles, protected spots in the swampy flood plains, but preferred drier land on the terraces and in the smaller valleys. Barten's study of settlement forms in Posen province reveals that the Prussian control in the early nineteenth century had a marked effect in causing the growth of isolated farmsteads in the empty stretches between the closed villages, but both farmsteads and villages were Polish in population. Aubin's map of the regions in which cities were founded under *deutsches Stadtrecht* shows this element of German culture extending far to the east, including all the Vistula basin: in most of the area the Magdeburg code was followed; along the Baltic, that of Lübeck.

Tiessen's study of the external trade of East Prussia emphasizes the changes

brought about not only because of the Corridor but also by the tariff separation of the area from Danzig and Posen. In Freymark's rather optimistic discussion the student of inland waterways will find detailed facts concerning the improvement of the Oder and the new Adolf Hitler Canal connecting it with the Upper Silesian industrial district but little about the traffic using it.

The importance of local climatic differences, both from place to place and from year to year, as revealed by Biel's study was of special interest to this reviewer. From this paper he learns that had he spent the winter of 1931–1932 only 60 miles farther west in the Silesian plain than he did he would have experienced only half as much "continental winter" (6 to 8 weeks of daily averages of less than 32° F. instead of 14 to 16 weeks) and that the winter he did experience was nearly three weeks longer than the normal for that locality. Biel's study supplements his maps in the "Atlas von Schlesien" (reviewed in *Geogr. Rev.*, Vol. 24, 1934, pp. 523–524).

RICHARD HARTSHORNE

ROADS OF THE ARGENTINE REPUBLIC

Memoria, Dirección Nacional de Vialidad, República Argentina, Vol. 1. Buenos Aires, 1933. 635 and xii pp.; maps, diagrs., ills. 10½ x 7 inches.

This is the first annual report of a new Highway Department of the Argentine government.

Beginning on January 1, 1933, the Argentines have set out to build a system of 27,000 miles of national roads and some 300,000 miles of provincial ones, to be completed in the next fifteen years. The nation will put 750 million pesos (sums in pesos may be divided by three to get United States dollars without great error) into the work, 450 million directly for national roads and 300 million as federal aid money for any province that will add as much more of its own, to be spent under strict control by the Federal Road Commission. Funds for the work are obtained mainly from a national gasoline tax of five centavos a liter.

It may not be realized that the Argentines are among the greatest users of motorcars in the world. To be precise, in 1930 only seven countries used more in proportion to their population, namely the United States, Canada, New Zealand, Australia, France, the United Kingdom, and Denmark.

The law provides for an apportionment of money expended, both for national roads and for federal aid to the provinces, in a way that guarantees its use in every corner of the land. Twenty per cent of the whole sum expended is divided among the provinces and territories in proportion to area, 40 per cent in proportion to population, and 40 per cent according to the local receipts of gasoline-tax money. The scheme is perhaps too kind to the almost uninhabited territories, with vast distances between few and small groups of settlers, though of course their needs are great.

The small, very densely peopled Federal District of Buenos Aires city gets only 300 pesos for its areal share, but 1,759,540 for its share by population and 2,990,604 for its share on the basis of gasoline tax. Tierra del Fuego, on the other hand, gets 36,455 pesos for its areal share, 3018 on the basis of population, and only 38 pesos on the basis of the gasoline tax. However, the Fuegian total of less than 40,000 pesos will not go far to make travel easy in those remote regions.

In every part of the country roads were put in two categories: very urgently needed roads, to be completed by the end of 1935, and a less urgent group, to be completed by the end of fifteen years.

As the areas involved are huge and the traffic light, 20,000 miles of the national roads are to be of cheap dirt construction, for the planning of which the services of Mr. Noel Anderson, of the U. S. Bureau of Public Roads, and Mr. Henry Aaron, soil expert, have been obtained. Another 4350 miles of national roads are to be of a better construction, and 1869 miles are to be of reënforced concrete. Bridges have

to be built almost everywhere, and the larger rivers in the territories have to be provided with ferries.

The new law is not concerned with highways alone but with all means of transportation. The commission is specifically ordered to make its roads lead to ports, rivers, and railways, that all kinds of transportation may work together for the good of the republic. Among other things, the present plan calls for construction by the Federal Road Commission with the railway-tax money (3 per cent of the net income) of access roads to the railways and for their being handed over to the provinces to keep in repair under the federal aid agreement.

The railroads caused a great increase of Argentine prosperity toward the end of the nineteenth century, when they filled in their network of rails on the fertile pampa and pushed lines to the principal mountain oases in the west. But the Argentine railways, like those of this country, were interested solely in transportation by rail. Once the rails were laid, they counted it no concern of theirs how the goods got to their lines. The fine loess of the pampa does not make good roads, but it is level, and before the railroads came it was traversed by long-distance roads in many directions. When the locomotive came these roads went at once into disuse. New tracks across the pampa began to converge on the stations along the railways, and the increase in traffic and its concentration at these points made the access roads bad in good weather and almost unusable when it was wet.

The railroads have been consulted in planning the new system of national roads, but they do not seem to have learned their lesson. They oppose all building of trunk roads parallel to their lines. One great trunk road that Argentine automobilists are a unit in demanding completed is that between the two largest cities, Buenos Aires and Rosario, of two million and half a million people respectively.

Perhaps the two most interesting features of this plan of road expansion are that it puts to the front the unity of all types of transportation—for even air traffic gets a word of mention—and that it proposes as a means of working out of the depression a facilitation of present labors rather than a mere shifting of the burdens of the present to the shoulders of future generations.

MARK JEFFERSON

A REGIONAL GEOGRAPHY OF THE YEMEN

CARL RATHJENS AND HERMANN V. WISSMANN. **Landeskundliche Ergebnisse** (Rathjens-v. Wissmannsche Südarabien-Reise, Vol. 3). xvi and 229 pp.; maps, diagrs., ills. (Hamburgische Universität, Abhandl. aus dem Gebiet der Auslandskunde, Vol. 40; Ser. B, Vol. 20.) Friederichsen, de Gruyter & Co., Hamburg, 1934. RM. 20. 11½ x 8 inches.

Geographically the Yemen is the most complex part of Arabia. A narrow desert coastal plain extends along the Red Sea. The interior is a rugged highland region, whose loftiest summit reaches an altitude of 3760 meters (12,336 feet) and is occasionally snow-covered. This is the highest measured point in Arabia, though there are possibly still higher mountains in Asir, to the north. The mountains of the Yemen were formed by the uplift and dissection of a group of plateaus, in places considerably broken by faulting and diversified by volcanic action. An extremely fragmented topography is reflected in pronounced local contrasts in climate, vegetation, tribal characteristics, religious sects, systems of agriculture, etc. Rainfall is sufficient to support a population much denser than elsewhere in the peninsula. Coffee and other crops are grown between elevations of 900 and 2100 meters, for the most part on terraced slopes facing the west and southwest.

In the winter of 1927–1928 Dr. Rathjens and Dr. von Wissmann carried out comprehensive archeological and geographical explorations in the Yemen. The archeological results are presented in the first two volumes of the publication of which the work under review constitutes Volume 3. In Volume 3 the country is described and

analyzed region by region. The text is fully illustrated with clear photographs and maps in black and white. Among the latter attention may be directed to distinctive maps showing the distribution of coffee culture and of tribal areas and village communities. The volume is also accompanied by a plan of the town of San'a and a colored map in three sheets (scale 1 : 100,000) of the region between Hodeida and San'a, partly based on original route surveys and partly compiled from available sources. So detailed and thorough is the treatment of climate, physiography, geology, vegetation, and human geography that the book is likely long to remain the outstanding authority on the subject.

It is of interest to note that what is probably the most accurate map in existence of the country within a radius of about seventy miles north and northwest of San'a is based on a survey carried out by the orientalist Eduard Glaser as long ago as 1883–1884. Glaser made careful observations of angles and tied these in to thirteen points determined astronomically. The results of this instrumental work were recorded in field diaries, whence Glaser transferred them, together with many details about the country, to a 142-page shorthand manuscript (now in the possession of the Vienna Academy of Sciences). From the data in this manuscript Josef Werdecker has been able to compile the map referred to. In the accompanying article (Neue Karte eines Teiles von Nordwest-Jemen, *Petermanns Mitt.*, Vol. 80, 1934, pp. 148–151) Werdecker takes occasion to give some details on Glaser's work as well as on other maps of the Yemen.

The Bedouins of Northern Arabia

Carl R. Raswan. **The Black Tents of Arabia (My Life Amongst the Bedouins).** 280 pp.; maps, diagrs., ills., index. Hutchinson & Co., London, 1935. 18s. 9½ x 6½ inches.

Today some of the Bedouin chiefs of northern Arabia possess automobiles. Mounted with machine guns and manned by tribesmen equipped with high-powered rifles, these cars are used with deadly effect in raids and intertribal wars. They are also employed in rapid reconnoitering for pasture or water. Distances are covered in a day or two that could hardly have been traversed in a week on camels or horseback. Thus modern inventions are altering the external circumstances of Bedouin existence. As yet, however, if we may believe Mr. Raswan, little fundamental change has taken place in the way of life and point of view of the nomads.

"The Black Tents of Arabia" is a narrative of adventures and incidents, interspersed with glowing descriptions of the desert and its high-spirited inhabitants. A man of feeling, the author writes well and thoughtfully; and he has been fortunate in finding an able translator, for the book was first published in Germany. The Bedouins, as he portrays them, are very much alive. The reader is made to sense the exultation of the raid or hunt in the crisp air, as well as something of the pathos of desert life, when famine threatens or a brave man is shot down from ambush. The photographs are exceptionally fine.

When still almost a boy, in 1912, Raswan was lured into northern Arabia by a passionate interest in the Arab horse. Since then he has many times revisited his friends among the Bedouins. Like Professor Alois Musil of Prague, he was accepted as a member of the Ruala tribe and made a "blood-brother" of their head chief. His book, although not a scientific treatise in any sense, supplements and brings up to date the observations recorded with such meticulous detail in Musil's "Arabia Deserta" and "The Manners and Customs of the Rwala Bedouins" (*Amer. Geogr. Soc. Oriental Explorations and Studies No. 2*, 1927, *No. 6*, 1928; see also Musil's popular volume, "In the Arabian Desert," New York, 1930).

In an Appendix Raswan gives some comprehensive notes on the Arab horse. "The climate of Arabia has, of course, something to do with the breeding and development

of these Bedouin horses. They are always roaming over the plains, and across the high plateaux, 2,000 to 3,000 feet up. A dry wind sweeps continually through this wilderness . . . There is no stagnation as in the settled districts of Arabia. Migration is life, and the horse of the desert, though undergoing the hardships and danger of it, comes out a finer product than the animal bred and raised in an oasis. It is, indeed, the test of the survival of the fittest that has preserved the fine qualities in the Arab [horse] throughout the centuries . . ."

The French Colonial Empire

Atlas des colonies françaises, protectorats et territoires sous mandat de la France, publié sous la direction de G. Grandidier. Text, maps (39 plates), diagrs., ills., indexes. Société d'Éditions Géographiques, Maritimes et Coloniales, Paris, 1934. 250 fr. 22 x 16¼ inches.

A conspectus of the present state of the French Colonial Empire, a domain covering nearly 11,000,000 square kilometers, supporting nearly 60,000,000 people, and possessing a great variety of resources. Ten authors, under the direction of Guillaume Grandidier, have contributed the several sections. First place naturally goes to French North Africa, for which E. F. Gautier is responsible. In addition to the fundamental hypsometric maps (1 : 1,000,000), other plates in color show geology, precipitation, and phytogeography (1 : 4,000,000), agriculture and, most notably, population classified by language (racial criterion is impossible) and habit (sedentary or nomadic). The maps with their clear transparent colors are most pleasing. The accompanying 48 pages of text contain many black-and-white maps, block diagrams, graphs, and sketches, and the concise regional descriptions are a particularly noteworthy feature. The remaining sections of the atlas, although less detailed, follow a similar plan with variation in treatment and emphasis and in number and scale of maps according to the character and extent of the territory, which ranges from vast French West Africa with its 4,620,000 square kilometers to the oceanic islands.

An excellent critique of the atlas by Ch. Robequain appeared in the January number of the *Annales de Géographie*. By comparison with the "Atlas des colonies françaises" of Paul Pelet published in 1902, M. Robequain brings out the progress achieved both in colonial development and in map making. He deplores the general omission of a bibliography and suggests that space might have been found for it by condensing the letterpress.

Map Projection

Charles H. Deetz and Oscar S. Adams. **Elements of Map Projection, with Applications to Map and Chart Construction.** 200 pp.; maps, diagrs., bibliogr., index. *U. S. Coast and Geodetic Survey Special Publ. No. 68*, 4th edit., revised, 1934. 11½ x 7½ inches.

O. S. Adams. **Flatland: Not a Romance But a Necessary Expedient.** Maps, ill. *Journ. Washington Acad. of Sci.*, Vol. 24, 1934, pp. 201–216.

In the fourth edition of "Elements of Map Projection," which has now become the standard reference work on map projection published in this country, there has been added a résumé of the systems of map projection that are of special interest in problems of the present day. Tables for the gnomonic projection of a map of the United States have also been added, the center of the projection or point of tangency being in latitude 40° and the middle longitude recommended being 96° W. The intervals of the projection are given for every degree. A new table for the construction of a parabolic equal-area projection for world or sectional mapping is given. In addition to these tables, the tables of two conformal projections for a map of the world are

also included, one being the development of the sphere within the area inclosed by a two-cusped epicycloid, the other a projection by Lagrange showing the earth's surface within a circle with center on the equator.

The study of map projections can become an absorbing and constructive hobby, and Mr. Adams in his address as retiring president of the Philosophical Society of Washington gives an entertaining account of how his enthusiasm was aroused and to what good purpose. Of particular interest is his description of the development in the United States for the use of local surveyors of systems of rectangular coördinates linked to the main geodetic triangulations of the country.

Elementary Geography of Daylight and Time

Lucia Carolyn Harrison. **Daylight, Twilight, Darkness, and Time: Their Distribution Over the Earth and Their Relationships to Human Affairs.** viii and 216 pp.; maps, diagrs., ills., index. Silver, Burdett & Co., New York, Newark, etc., 1935. $1.24. 8 x 5½ inches.

The title of this little book is an adequate summary of its contents. The facts about, and the effects of, daylight and the seasons are explained simply in a way calculated to arouse the interest of anyone unfamiliar with them. To those whose interests, mental and otherwise, lie in other directions but who occasionally require to refresh their memories about the elementary geometry of their environment the book will be found to be a useful reference.

The presentation of the material on the whole is good, particularly in the way a subject is introduced by presenting first a pertinent statement from some newspaper or other report. The illustrations are clear, and there are useful tables for determining such items as the times of sunrise and sunset and the seasonal amount of daylight at various latitudes. Problems at the end of the book are designed to test the reader's ability to absorb the facts presented and act as an adequate check on a too lazy reading of the text. One note of criticism may be sounded. The author in her meritorious attempt to be simple has occasionally let her writing become befogged in its own simplicity.

The Wegener Expedition to Greenland

Johannes Georgi. **Mid-Ice: The Story of the Wegener Expedition to Greenland.** Translated by F. H. Lyon. xiv and 248 pp.; map, ills. Kegan Paul, Trench, Trubner & Co., London, 1934. 12s. 6d. 9 x 5½ inches.

Wissenschaftliche Ergebnisse der Deutschen Grönland-Expedition Alfred Wegener 1929 und 1930–1931. Vol. 4, 1 : **Die Eismittestation,** Part I, by Johannes Georgi; **Die Oststation,** by Walter Kopp. viii and 559 pp.; maps, ills. F. A. Brockhaus, Leipzig, 1935.

The greatest of all recent expeditions to Greenland, that of Alfred Wegener in 1930–1931, is the subject of this thrilling narrative, which has special reference to the station of Eismitte, set up in the middle of the great icecap for study of meteorological conditions. It is a translation of "Im Eis Vergraben," which appeared in 1934. The courage and fortitude shown by Dr. Georgi, the second-in-command of the expedition and in charge of the station, are beyond praise. For complete success, favorable weather conditions were essential, and it seemed that the expedition was marked from the start by one stroke of ill fortune after another, until these culminated in the loss of Wegener and his Eskimo companion with defeat in the eleventh-hour effort to complete the provisioning of the station. In the face of all these discouragements Georgi carried on and achieved scientific results of the very greatest importance. The book is the diary of the author as recorded day by day, with little later editing to

obtain literary effect. It will remain one of the great stories of achievement in polar exploration made in the interest of science. The book is introduced by Captain Ejnar Mikkelsen, the veteran Danish Arctic explorer.

The plan of Wegener's expedition of 1930–1931 was throughout meteorological and was made: "(a) to fix the winter temperatures within the cold core of the Greenland glacial anticyclone; (b) to settle special questions concerning ice supersaturation, rime, mist, calms, daily temperature range throughout the different seasons, and glacier nourishment; (c) migration of cyclones over the inland ice, and their structure; (d) radiation and optical air measurements; and (e) to learn the vertical composition of the glacial anticyclone through determination of the distribution of temperature and wind above the station, which, together with corresponding observations made at the west and east stations, should furnish an 'aerological profile of the glacial anticyclone.' "

These final reports give in full the meteorological observations, the earlier summaries of which have already been reviewed in this journal (Vol. 22, 1932, pp. 681–684). An impressive summary of the observations at the Eismitte station is supplied by a large folded diagram on which the meteorological elements are graphically represented for the entire period of occupation of the station, which was slightly more than a year.

As regards the ground observations, Kopp makes the important admission: "The local climate of the interior of the fiords has such a marked effect upon the temperature registration, that this is valueless for the most part for synoptic considerations." The same statement might have been added for the winds, which are even more important in the part they play in preparation of the synoptic map.

W. H. Hobbs

Contributions to the Science of Social Needs

Theo Surányi-Unger. **Weltwirtschaftspolitik im Entstehen: Beiträge zur Lehre von den Gemeinbedürfnissen.** vii and 307 pp.; diagrs., index. Gustav Fischer, Jena, 1933. 9¼ x 6¼ inches.

The publication in 1931 of Surányi-Unger's "Economics in the Twentieth Century," translated from the German, and edited by Professor Seligman of Columbia University, introduced this Hungarian economist to a wide circle of English-speaking social scientists. Since that time Surányi-Unger has worked in fields closer to the geographer's sphere of interest. In part financed by the Rockefeller Foundation, he spent several years traveling on five continents. Although he has treated in magazine articles in German, French, English, or Hungarian special regional problems such as nationalism in India and socioeconomic problems of the Pacific area, of the U. S. S. R., and of Latin America, in this book he offers a more unified approach to the broader questions of world economics and policy. He distinguishes two phases or aspects of world economics: the external projection of national policies into the international field and the creation of an independent supernational cosmopolitan social will and a social organism as large as the ecumene itself. It is this second concept of world economy whose emergence in its political manifestations Surányi-Unger discusses in this volume. In other words, he looks beyond the era of "nationalism" with its international fringes to a cosmopolitan era that may or may not retain nationalistic features.

Surányi-Unger bases his hopes for the coming of such a world economy on a rather novel interpretation of the modern "nationalistic" trend. In sharp contrast with most interpreters, who regard this "nationalism" of today as a disruptive process or a centrifugal force, Surányi-Unger interprets the rise of "nationalism" in many parts of the earth as a symptom of progressive Westernization and hence of world-wide institutional assimilation. Far from concurring in the popular view that these

nationalistic adventures are forcing people farther apart, Surányi-Unger considers them merely as steppingstones to a lofty goal of more complete Europeanization. This process manifests itself to him not through a wholesale subjection of ever wider areas to European political and economic domination but through the repetition in different parts of the earth of evolutionary trends similar to those through which Europe passed centuries ago.

The main part of the study is a statistical analysis—summarized in the Appendix in the form of several logarithmic graphs—of public expenditures of thirty countries. These thirty countries were selected with a view to getting as heterogeneous an assortment as possible. The list speaks for itself.

Europe: Great Britain, Germany, France, Spain, Italy, Hungary
America: The United States, Canada, Mexico, Brazil, Uruguay, Argentina
Asia: Soviet Russia, Turkey, Japan, China, British India, Persia
Africa: Egypt, Tunisia, French Morocco, Union of South Africa, Southwest Africa, and Mozambique
Australasia and Oceania: Commonwealth of Australia, Queensland, New South Wales, Victoria, New Zealand, Hawaiian Islands

This juxtaposition of heterogeneous social structures contains obvious elements of weakness. Surányi-Unger himself is thoroughly aware of the almost insurmountable difficulties of his task and continually warns his readers on the conclusions to be drawn. He knows that a comparison between the public expenditures of Tunisia and the United States, of British India and Germany, of Persia and France—to name only six of the thirty countries—comes close to being a comparison of incomparables. Probably more than half the book consists of an elaborate discussion of social, psychological, ideological, and philosophical elements that must be taken into consideration in interpreting the budgetary statistics.

Surányi-Unger finds that during the two decades after 1913 the trend of public expenditures seems to indicate a gradual waning of the lust for political power (*Machtpolitik*) and a heightened interest in cultural and social problems. The simple fact that the period under consideration, 1913–1932, covers not only the World War and its immediate aftermath but also the boom of the late twenties and at least the first part of the depression arouses doubt, if not suspicion, concerning the dependability of any kind of general conclusions drawn from a world-wide statistical survey of this sort. One wonders how Surányi-Unger's own conclusions would have turned out had he postponed the publication of his volume a few years longer. He finished his book before Hitler appeared on the scene, before Japan bombarded Shanghai and marched into Manchukuo, before international naval agreements were scrapped—in short, before a veritable bumper crop of discouraging and disheartening phenomena blighted the hopes of even the most ardent cosmopolitan enthusiasts.

The interpretation of world trade as primarily a political phenomenon must shock the sensibilities of many Anglo-Saxon readers who still cling to the individualistic traditions of classical or neoclassical economics. Surányi-Unger sees the world divided into powerful and weak groups. Trade between these does not necessarily involve mutual advantage but more likely than not leads to the exploitation of the weak by the strong. At the one extreme he sees large economic entities well endowed with the basic resources of industrialization; at the other extreme he places monocultural regions specializing in the production of luxury goods. These regions can exercise little actual control over world trade; the economic entities are predestined to take the initiative and to exercise control. Such a conception is not altogether different from that given by this reviewer in his various writings on the resource hierarchy of modern world economy. The hierarchical interpretation is more articulated and elaborate. This reviewer seeks the causes of international disparities in lower strata and places the emphasis on the different degree in which the capitalistic method lends itself to various economic activities.

The question arises why a book of this nature should be of interest to the geographer and should, therefore, be reviewed in this journal. The philosopher's diary of a Count Keyserling might not contain any direct reference to geographical influences on cultural developments and yet be of unusual interest to the geographer, who, facing a novel interpretation of a cultural landscape, is stimulated to supplement the philosopher's analysis with his own geographical critique. Surányi-Unger is one of the most prolific writers in the field of world economics. Even if his reports on years of travel in five continents contained not a single direct reference to geographical influences, his findings should nevertheless prove of great value to all those who are interested in geography—the description of the earth as man's home.

ERICH W. ZIMMERMANN

OUR RAW MATERIALS IN THEIR INTERNATIONAL ASPECTS

BROOKS EMENY, with the statistical assistance of J. Edward Ely. **The Strategy of Raw Materials: A Study of America in Peace and War.** xiv and 202 pp.; maps, diagrs., bibliogr., index. (Bureau of International Research, Harvard University and Radcliffe College.) The Macmillan Company, New York, 1934. $3.00. 9½ x 6½ inches.

During and since the war so many books and articles have been published on various phases of the international and war aspects of raw materials—minerals, foodstuffs, rubber, fibers, hides, etc.—that one finds this carefully prepared volume by Dr. Emeny, with its excellent diagrammatic maps and charts, a most useful and timely work. The author brings together in one compact volume all the different threads of the problem and examines critically and statistically the national self-sufficiency of "The Seven Great Powers"—the United States, Germany, Great Britain, France, Russia, Italy, and Japan—in foodstuffs, essential industrial products, and raw materials, in both peace and war.

In the preparation of this book the author has worked with not only the large amount of source material contained in the numerous publications listed in the bibliography but also important data in the files of the Commodities Division of the Planning Branch of the Office of the Assistant Secretary of War. The files of the Commodities Division he recognizes as his "most valuable single source" and explains that "although a large part of the information contained therein is not available for publication, considerable data, directly related to the subject at hand, have been placed at the disposal of the author for use in the manuscript." Dr. Emeny concludes from his analysis that of "the twenty-six different commodities, the problem of procuring which in time of war is considered sufficiently difficult by the War Department to warrant their being classed as 'strategic,' no more than five or six of these are of really vital concern."

Regarding the all-important ferro-grade of manganese ores, he concludes that the purchase of a stock pile of 700,000 to 1,000,000 tons, to be used only in extreme emergency, "would be unquestionably the most economical [course] and would offer the greatest degree of security." There is thus no difference between the conclusion of Dr. Emeny on this point and that reached by many others who have studied the manganese situation and made recommendations concerning it. He points out that such a purchase could be made with two or three years' revenue from the present tariff on manganese. Lesser stock piles of chromium ore and tin ore or tin are likewise recommended, but tin is considered a convenience rather than a military necessity.

With respect to antimony and tungsten, he is of the opinion that "adequate assurance of security can be gained through the maintenance of careful regulation and control, with all developments in potential national resources, and improvements in the use of substitutes, being made a matter of detailed record." He points out that

even drastic regulation would probably not be required for either of these minerals, because deposits in Bolivia, Peru, and/or Mexico could be counted on to furnish supplies under almost any war contingencies.

As regards rubber, he concludes that the purchase of a stock pile for war use would be unwarranted under present conditions, because substitutes and secondary recovery would afford assurance of security under most conditions; but in his opinion a stock pile might become a matter for consideration, if drastic rise or fall of price should seriously reduce the size of crude stocks normally kept on hand.

He would remove all the remaining raw materials from the "strategic" list of the War Department and place them under two classifications:

1. "Critical raw materials," that is those in which he finds there is little question that all essential war needs could be met, in extreme emergency, by substitutes, increase in domestic production, and, in the case of nickel, possibly emergency seizure of Canadian sources, which necessity would arise only, and would naturally follow, in case of war with Great Britain—mercury, mica, nickel, Manila fiber, sisal, wool, hides, opium, quinine, coconut shells, and coffee.
2. Materials that he finds there is now no reason for retaining on the "strategic" list, or even including in the "critical raw materials" list, because "adequate plans for the procurement of necessary supplies or substitutes thereof have been thoroughly devised, and need only to be put into proper execution in time of a war emergency"—nitrates, platinum, camphor, iodine, jute, nux vomica, shellac, raw silk, sugar.

As an insurance precaution regarding nickel, he suggests that our five-cent pieces be made of pure nickel instead of having a nickel content of only 25 per cent as at present, inasmuch as this would increase the reserve supply, available in case of necessity, more than 5000 tons. Such a plan, he points out, has already been adopted as a measure of national security by Great Britain, Germany, France, Italy, and Japan for minor coins and, he adds, "will undoubtedly be resorted to as a defensive measure by Russia in the near future."

Dr. Emeny finds: (1) "that in so far as resources in raw materials and foodstuffs may be taken as a factor of national power, the situation of the United States is without parallel"; (2) that not only is this country more self-contained in these but the foreign sources of supply of the strategic commodities we lack are more readily available to us than to any other industrialized state; and (3) that the "richest raw material regions of the world are in great part under the dominance of the Anglo-American Powers; and that these two national groups, which account for over 60 per cent of the world's industrial output and exercise financial or sovereign control over 75 per cent of the mineral resources, hold the balance of power in so far as the essential commodities of peace and war are concerned."

A. C. VEATCH